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PRICE 20 CENTS TABLE OF CONTENTS PAGE 49 MARCH 15, 1947

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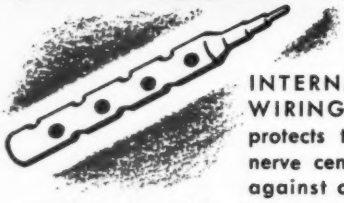

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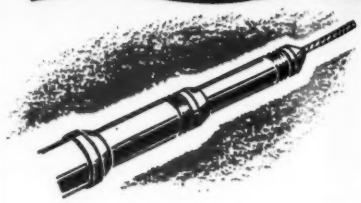

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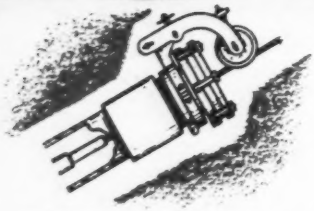

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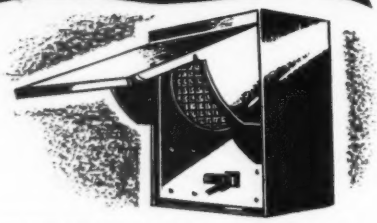
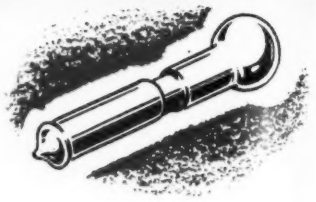


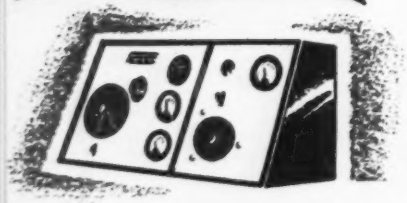
TWO-WAY COMMUNICATION — permits Lane-Wells operator, in truck, and rig man to be in contact at all times.

SAFETY SWITCH



SAFETY SWITCH — on Rig Floor — protects the rig man and crew while the gun is out of the hole.

CONTROL PANEL



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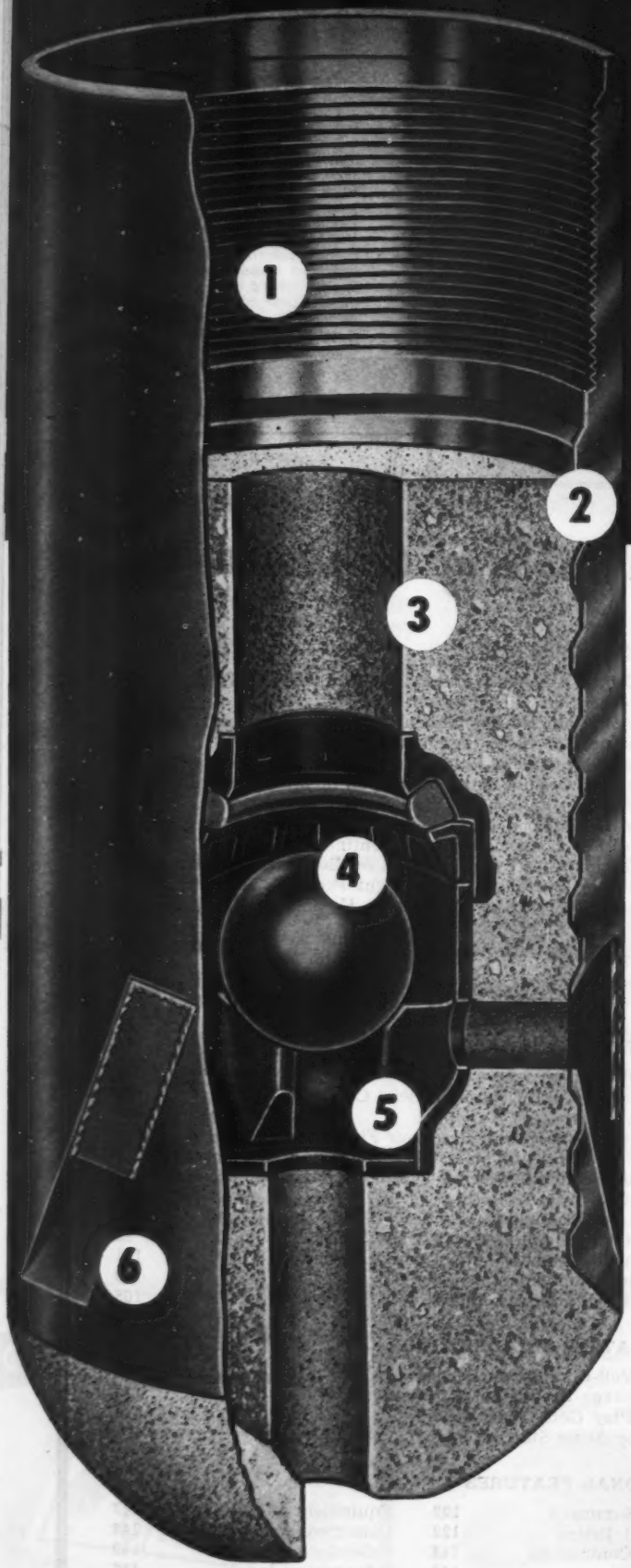

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Higher Prices

THE increases in the posted prices for crude oil which got under way Monday reflect basic conditions which currently exist in supply and demand.

Late in 1946 the oil industry's economists projected the year's petroleum requirements taking into consideration domestic and international conditions. Without exception their prognostications, including that of the Bureau of Mines, agreed that petroleum demands this year would exceed the record yearly totals of 1946. With these conditions in mind the needed supplies were estimated.

But it is now certain that the estimates of 2 to 4 months ago for this year were too low. Demand in practically every product has exceeded expectations, with every indication that consumption this year compared to 1946 will further expand as the year progresses. The late 1946 stock accumulations were under rather than in excess of needs.

An over-all gain of 5 per cent which now appears to be a minimum increase for this year over 1946 may not appear large to outsiders, but it means that approximately 260,000 bbl. daily of additional crude oil must be made available in this country. So far this year total domestic crude-oil production has been about the same as last year.

While consumer requirements in all products have been supplied, many refiners do not have the stocks on hand they should have for this time of the year. They will need substantially more crude oil for the final 3 quarters than the average runs of the first 3 months. This is particularly true at many plants in the Middle West and Mid-Continent where new supplies have not kept pace with the new demands.

The season of maximum gasoline consumption in this country is at hand and the inventories at refineries and bulk stations are less than they were a year ago. Last year's gasoline-consumption expansion was accounted for by the increased use per car. This year gains will come from more vehicles on the highways and streets as well as further increases per unit.

The advances in posted crude-oil prices with adjustments in refinery, wholesale, and retail prices will not change the situation of many years' standing in which petroleum products have always been "cheap." The latest index on retail gasoline was 75, which compares with a general commodity index of 165.4. The crude-oil price index in January was 89, while that of all raw materials was 153.

The slightly higher prices to consumers are their only protection. The new quotations will expand production and bring about whatever changes are expedient in the flow of crude oil and products to assure the required supplies wherever needed.

PETROLEUM—A *PROGRESSIVE* INDUSTRY

25-Cent Crude Advance Initiated By Indiana Standard

A 25-CENT price increase which promised to bring producers the highest sustained price for their crude since 1920 was announced March 10 by Standard Oil Co. (Ind.) and Stanolind Oil Purchasing Co.

Shortly after the two announcements, Stanolind Oil & Gas Co. announced similar increased postings, and was followed immediately by Deep Rock Oil Corp., Phillips Petroleum Co., Skelly Oil Co., Ohio Oil Co., and Simrall Corp.

Monday afternoon more oil companies followed suit in the price hike. They included: Pan American Oil Producing Co., Sohio Petroleum Co., Atlantic Refining Co., Sunray Oil Corp., Bell Oil & Gas Co., Chanute Refining Co., Missouri Farm Association, El Dorado Refining Co., Kanotex Refining Co., Shallow Water Refining Co., Derby Oil Co., Vickers Petroleum Corp., and The Texas Co.

Magnolia Petroleum Co. announced it will increase, effective 7 a.m. March 10, the price of crude 25 cents for all grades in all areas where it posts. Sinclair Prairie Oil Co. and Sinclair-Wyoming Oil Co. announced they are increasing prices in all areas where they are competitive with Stanolind.

The new postings put Oklahoma and Kansas crude at $1.55 a barrel for 21°-gravity and below with a 2-cent differential to $1.95 per barrel for 40° gravity and above.

For the same gravity scale, North Texas crude was pegged to range from $1.55 to $1.95; West Texas, $1.42 to $1.82; Gulf Coast "A," $1.78 to $2.18; Gulf Coast "B," $1.65 to $2.05; Wyoming "A," $1.55 to $1.95; Wyoming "B," 15° gravity and below, $1.20 to 32° and above, $1.62½; Colorado, $1.45 to $1.85.

The price boost followed establishing in January and February of a trend in petroleum consumption nearly 500,000 bbl. daily above previous estimates. The Independent Petroleum Association of America this week predicted January and February consumption figures will show a total of nearly 5,900,000 bbl. daily.

The boost jumped Oklahoma and Kansas crude to its highest price since 1926, when it brought $2.31 for a short time, and to what apparently will be its highest sustained price since 1920, when the year's average was about $3.25.

It was the fourth general increase within the past 12 months and brought postings to 70 cents above those of a year ago.

Based on current production, the increase means an additional income of about $970,000 a day to producers in the affected areas, including some $532,000 which will go to Texas operators. For many stripper-well operators, this week's increase represented the first actual additional realization for their crude since price decontrol. The government subsidy, ranging up to 35 cents per barrel for wells producing 9 bbl. daily or less, has been progressively reduced by the amount of previous crude advances, thus offsetting the July and November increases which totaled 35 cents.

No adjustment was anticipated in Pennsylvania posted prices until the end of the subsidy March 31.

South Penn Oil Co. increased Corning grade in Ohio 25 cents to 2.01 following announcement of the Mid-Continent increase.

In California, oil officials were watching for any action by Standard Oil Co. of California, market leader on the West Coast. California Standard's San Francisco office said no immediate crude raise was in prospect but added the situation may change in the next few days.

Robert G. Dunlop to Be Sun Oil President

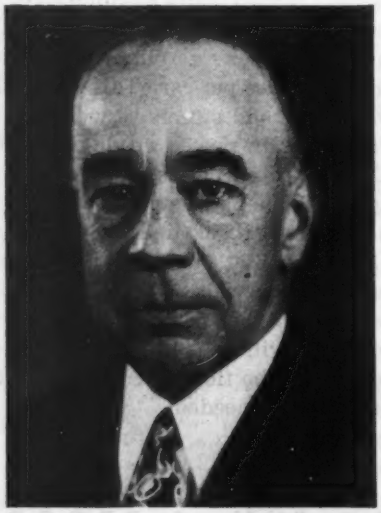
PHILADELPHIA.—Following 35 years as president of Sun Oil Co., J. Howard Pew has announced plans to retire March 18 when the company's stockholders hold their annual meeting.

Joseph N. Pew, Jr., executive vice president, will be recommended to a newly created post of chairman of the board of directors, and Robert G. Dunlop, comptroller, will be recommended for the presidency, the retiring president said.

Arthur E. Pew, Jr., has resigned as vice president in charge of manufacturing, but will continue as a member of the board. J. Howard Pew stated that he will recommend expansion of the board from 11 to 15 members and the creation of an executive committee, adding that he will be happy to continue as a board member.

Joseph N. Pew, Jr., has been with Sun since 1908 and aside from his duties with Sun Oil, he is also board chairman of Sun Shipbuilding & Dry Dock Co., a wholly owned Sun Oil subsidiary. Dunlop has been with Sun since 1933. In 1944, at the age of 34, he was elected to the board of directors.

A native of Boston, Dunlop joined Sun Oil in 1933 after 2 years with the accounting firm of Barrow, Wade, Guthrie & Co. His early activities with the company included a complete survey of producing, refining and marketing operations in light of the old NRA petroleum code. He assisted in the presentation of the oil-industry testimony before the Temporary National Economic Committee in 1939. Dunlop is a member of the Comptrollers Institute of America and the American Petroleum Institute and is currently serving as vice chairman of the A.P.I. financial and accounting committee.



JOSEPH N. PEW, JR.

R. G. DUNLOP

Law's Intent Plain, Amendments Not Needed, FPC Report Says

WASHINGTON.—The Natural Gas Act gives the Federal Power Commission no jurisdiction over production and gathering activities nor over arms-length sales of gas for interstate transmission, and the commission should make an administrative ruling to this effect, the FPC staff has concluded as a result of evidence submitted during the natural-gas investigation.

The language of the act and the intent of Congress on this point are so clear that there is no need for amendatory legislation, the staff declared, but the commission should set the industry's fears at rest by a formal declaration under the administrative procedures act.

This recommendation was in a section of the FPC preliminary report on the gas investigation dealing with Section 1(b) of the gas act, now being distributed to the industry for comment along with three other sections dealing with production aspects of the natural-gas business. The others deal with state conservation laws and activities, natural-gas reserves of the United States, and practices and problems in producing, gathering and processing natural gas.

While this staff recommendation has not yet been formally approved by the commission itself, it is unlikely that the commissioners will take a contrary view since the finding coincides with the unanimous opinion of the industry and the state regulatory commissions. The four reports were sent out to interested parties over the signature of Chairman Nelson Lee Smith with a request for comment by April 1.

The report concedes that regulation of production and gathering was the subject of greatest concern during the investigation and that the industry and the state commissions are greatly disturbed over a line of FPC decisions which suggest that the commission is reaching out for this jurisdiction. It admits that there is some justification for this fear and that clarification is necessary.

The staff makes a distinction between gas produced and gathered by one party and sold in an arms' length transaction to an interstate transmission line, and gas produced by a transmission company itself. The latter situation is to be discussed in a forthcoming section of the report dealing with field prices for gas, and the current section discusses only production and gathering by parties other than transmission companies.

Both state commissions and the oil and gas industries are so disturbed over the possibility of production and gathering regulation that development of the industry is being held back and conservation is suffering, the report says, and there is a real need for immediate clarification of the commission's authority.

The other three sections of the report are largely factual summaries of the historical, legal, and technological aspects of the subjects covered. However, the section on state conservation laws and activities contain a chapter of the role of the federal Government in gas conservation which declares that the FPC's rate-making policies should take account of the effect of rates on conservation and state regulation.

The staff rejected a proposal, advanced during the investigation, that interstate transmission companies be required to divorce themselves of their production and gathering activities. The staff also concluded that there is no need at this time for a federal "hot gas" act. *(For comments on the report, see Watching Washington, page 68).*

Merger of Oil, Gas Firms To Be Voted on March 25

Stockholders of El Paso Natural Gas Co., owners of Western Gas Co., will vote March 25 on a proposed merger of Western with Gulf States Oil Co. to form a new company large enough to finance its own operations and diversify operating risks.

Majority of Gulf States stock is owned by Paul Kayser, El Paso president, and his associates. The new firm would be known as Western Natural Gas Co.

Hull Takes Texas Co. Vice President Post

Burt E. Hull has resigned as president of Texas Pipe Line Co. to become vice president of The Texas Co. He will be succeeded as head of the subsidiary pipe-line company by Ralph B. McLaughlin who became vice president and manager of Texas Pipe Line and Texas-New Mexico Pipe Line Co. in 1943.

B. E. HULL

Hull is on a leave of absence to serve as president of Trans-Arabian Pipe Line Co., in which capacity he will supervise construction of the 1,050 mile, 30 to 31-in. crude-oil pipe line from the Persian Gulf area to an as yet undisclosed Mediterranean port, possibly in Lebanon. Hull served as vice president and general manager of War Emergency Pipe Lines, Inc., supervising construction of the Big Inch and Little Big Inch lines.

A native of Texas, Hull joined Texaco in 1905 as a junior engineer, later becoming chief engineer of the refining department. In 1922 he was transferred to Tampico as vice president and general manager in charge of production, refining, pipe-line, marine, and sales operations of Texas Co.'s Mexican operations. (A biographical sketch of McLaughlin appears on page 144).

Patent Features of U. S. Research Bill Opposed

WASHINGTON.—Support of legislation to create a national science foundation to foster basic research was given by Bruce K. Brown, vice president in charge of development for Standard Oil Co. (Ind.) at hearings last week before the House committee on interstate and foreign commerce.

But, like most of the other witnesses, Brown emphatically opposed provisions in some of the pending bills which would deny patents to any discoveries made by research laboratories or institutions obtaining any federal funds for research projects. He endorsed bills which would direct the foundation to make research contracts with patent clauses satisfactory to both the Government and the research institution.

In this way, Brown explained, the contract could provide that the Government have the rights to any patentable discovery made on a direct assignment by the Government, but the research agency would be able to patent incidental discoveries or inventions made in the course of research not connected with the government assignment. The bills which Brown opposed would revise the patent policy of the entire Government by requiring public patents for any invention made by any researcher in any government agency or in any private agency receiving any federal funds or contracts.

While this latter type of bill had considerable administration support last year, it was opposed by virtually all the witnesses at current hearings.

Texas Operators Oppose Rules on Deviation, Multiple Completions

AUSTIN.—Representatives of Texas oil operators last week voiced almost unanimous opposition to any Railroad Commission rules which would arbitrarily limit well hole deviation or provide blanket permission or restraint on multiple well completions on a state-wide basis. The occasion was a state-wide hearing called by the commission to obtain evidence and testimony on the two matters as a basis for possible rules.

At the beginning of the hearing on well-hole deviation, William J. Murray, Jr., sole commissioner present, stated that it is not the intent of that body to require straight holes so long as surface spacing rules were not disrupted on inside locations in proved fields. Nor is it intended, he added, to increase the cost of drilling in Texas. The objective is to draw up rules which will provide the commission with machinery for dealing with controversies arising from drilling of crooked holes and also provide sufficient control over intentional direction drilling.

Consensus of the industry represented at the hearing fell generally into the following: (1) That in normal drilling operations, contractors and operators try to drill as straight a hole as possible within reasonable limits; (2) that 100,000 wells have been drilled in Texas so far without undue abuse arising from crooked holes or intentional directional drilling; (3) that any state-wide limitation set on allowable deviation would be unwise since such a rule would not take into consideration spacing programs and other factors which vary from field to field; (4) that the question should be considered on the basis of intent, and that operators unintentionally drilling crooked holes should not be forced to shut down during drilling or be required to make directional surveys unless a clear case of spacing violation was indicated.

Operators generally gave no objection to reasonable rules governing intentional directional drilling, agreeing that such a practice should require application for a permit followed by a directional survey of the hole. The setting of graduated allowable deviations for various spacing patterns was suggested by one company and endorsed with modifications by others, allowing 3° from vertical for wells located 150 ft. from a lease line, 4° for a 150 to 300-ft. distance and 5° for distances exceeding 300 ft. This yardstick was questioned by other operators who pointed out that displacement of the bottom of the hole from the surface location was the important factor and deviation alone should not govern without considering depth and the possible compensating effect of deviation in opposite directions down the hole.

Judging from the expressed opinions of operators present at the hearing, the commission is not expected to set rigid deviation limits for all drilling throughout the state, but may, as was suggested by one operator, draw up a proposed rule taking into consideration certain exceptions, and possibly call a rehearing on the subject to hear testimony on that proposed rule.

Dual Completions Supported

Those who expected to hear numerous objections to permitting multiple completions in new fields in Texas were surprised to find that evidence and opinion from the operators present predominately supported the practice and declared generally that it resulted in increased oil and gas development and recovery in the majority of cases where it has been followed in the past. Operators strongly objected to the commission's setting any state-wide policy either for or against allowing such completions in fields where they are not yet practiced.

The consensus favored treating each field or reservoir as a special case; the commission's decision to be based on a field-wide hearing in which all operators producing in such a field should participate. This brought up the question of how far development of a new field should procede before such a decision is made, since delay would penalize early operators who wish to complete dually, and an early decision would be based on limited information from a fraction of the operators who will ultimately produce the field.

Opinion was divided on the question of whether dualling permits should be issued on a well-to-well or a field-wide basis. Since the commission is generally bound to permit additional dual completions once it has authorized them in a particular field or reservoir and cannot reverse itself unless subsequent waste occurs or horizons originally thought separate prove to be common, that body was asked to weigh evidence very carefully before any policy is stated, or any decision is made on individual cases which come before it in the future.

While it was recognized at the hearing that multiple completions are out of the question where casing corrosion is threatened or paraffin content of crude is high, several operators testified that marginal horizons opened to production by this means would not have justified drilling separate wells.

Not all testimony favored dual completions. One representative of East Texas operators stated his opposition, based on the trouble he had had in completing dual wells in Carthage field. He advanced the opinion that operators who did not wish to undertake the risks of dually completing wells would be forced to do so or to drill twin wells if offset operators were allowed to produce two separate horizons simultaneously from one dual well. He suggested depletion of one horizon at a time.

Another company opposed dual oil-oil completions, adding its opinion that such practices entailed additional operating problems and that production of oil through the annulus was inefficient. The company believed dual oil-gas or gas-gas completions not so difficult and favored their being permitted, but only after each case is considered on its merits.

Tools Are Adequate

Packer trouble was discussed, the general opinion being that most leaks arose from improper initial setting of packers. The mechanical tools available for making dual completions today were declared adequate if employed properly.

When asked for opinions on rules for policing and testing dual completions, operators, granting the commission's inability to make regular periodic checks, suggested that they test their own wells at regular intervals and file reports with the state. Some felt monthly tests of production from oil-oil wells were necessary to check comingling of fluids from separate horizons, and checks on gas wells on a 90-day or 6-month basis would be sufficient. Others recommend tests every 90 days on all types of dual or triple completions.

Although the Railroad Commission is legally concerned with determining the effect of dual completions on prevention of waste and conservation of oil and gas and not with the economics of development and production, the two were declared closely related by some operators. It was pointed out that more costly exploration, deeper drilling, and increased prices for labor, equipment, and supplies may preclude development of some horizons in future fields unless multiple completions are allowed.

this week

PRICES— Indiana Standard, Stanolind Crude Purchasing announcements of an over-all 25-cent crude increase touches off what appears to be a general advance. . . . Crude raise is fourth in last 12 months and promises to lift crude prices to their highest stable level in 27 years. . . . Price for top-gravity Mid-Continent oil now $1.95. . . . Increase is first for many stripper-well operators which will not be offset by corresponding subsidy reduction. . . . ¶Products markets strengthen as a result of the crude advance. . . . Motor fuel, in the face of expected record consumption this summer, expected to carry much of the crude raise. . . . Eight-cent Group 3 price by midsummer or earlier anticipated. . . .

FPC— Commission staff issues report on natural-gas investigation declaring Natural Gas Act plainly denies any FPC jurisdiction over production, gathering, or sales prior to interstate transmission. . . . Report declares legislation clarifying the act is not needed but recommends clear-cut statement of policy by the commission. . . . ¶Representative Rizley appears before House committee and obtains early hearings April 14-15 on his bill to restrict the commission's jurisdiction. . . .

BIG INCH— FPC's advisory committee of Big Inch gas allocations makes minor changes in amounts received by distributing companies. . . . Committee recommends uninterrupted use of the lines for gas movement following expiration of T. G. & T. temporary lease April 30. . . .

PIPE LINE— WAA receives eight bids for war-built Greensboro, N. C.-Richmond, Va., extension of Plantation pipe line. . . . Apparent high was Keystone Pipe Line Co., Philadelphia, with $477,000 offer for line and all equipment. . . .

EXPLORATION— Gulf Oil deep test in shallow Penwell area, Ector County, Texas, flows 1,032 bbl. 41.6° gravity oil plus 100 bbl. water from Ellenburger. . . . ¶Coastal Refineries, Inc., W. D. Kennard discovery east of Boyle pool and south of Rincon in Starr County flows 38 bbl. 45° gravity oil. . . . ¶Sun Oil well, flowing 38 bbl., extends South Kelsey field in Starr County. . . . ¶Superior Oil Co. test in Altair field, Colorado County, flows 96 bbl. 48° gravity condensate, proving deeper pay zone at 10,304 ft. . . . ¶ Humble test in Avery Island field, Iberia Parish, Louisiana, flowing 211 bbl. daily, makes new sand discovery at 8,077 ft. . . . ¶Pure Oil and Stanolind Oil & Gas Clay County wildcat in extreme southeastern Kentucky may open entirely new area. . . .

INTERNATIONAL— Jersey Standard, Socony-Vacuum, and Anglo-Iranian organize new company, Middle East Pipe Lines, Ltd., which will build and operate the projected 1,000-mile, 26 to 30-in. crude line from Iran and Kuwait to the Mediterranean. . . . Route of line, the second major Middle East pipe-line project, now being surveyed. . . . ¶Despite previous reports indicating the Red Line Agreement is still valid, Jersey Standard and Socony-Vacuum proceed with plan to buy into Arabian American. . . . Working arrangement expected to be announced soon. . . . ¶Creole's January production reaches new high of 586,715 bbl. daily. . . .

REFINING— Rock Island Refining Corp., Indianapolis, buys Onyx Refining. . . . Sale includes West Central Texas gathering system and plant 9 miles north of Abilene. . . . ¶Hovey Petroleum announces plans to build $200,000 paraffin-wax and asphalt plant in the Houston area. . . .

A new wrinkle in oil-well cementing was introduced recently when California Co.'s 1 Lepine in a waterway near Barataria, La., was cemented with equipment permanently mounted on a self-propelled barge. It also was the first adaptation to offshore operations of Halliburton Oil Well Cementing Co.'s method of handling cement in bulk. Shown here is the barge, a converted LCT, which will serve as a pilot model for a fleet of the units to operate along the Louisiana coast. The vessel carries the equivalent of 2,000 sacks of cement, plus necessary pumps, measuring tanks, and other equipment. A crew of six, including two cementers, operates the barge

International

WORLD-WIDE OIL DEVELOPMENTS

Jersey, Socony, Arabian American Working Agreement Due Soon

by Warren W. Burns

DESPITE the legal opinion given Iraq Petroleum Co., Ltd., that the already famous Red Line Agreement was reinstated by certain postwar business transactions among the partners of I.P.C., all indications here in New York are that Standard Oil Co. (N.J.) and Socony-Vacuum Oil Co., Inc. (participants in I.P.C. through joint ownership of Near East Development Corp.) will continue to reject this line of reasoning.

In fact, the belief that the agreement legally can be proven as no longer in existence—if Cie. Francaise des Petroles insists that its case be tried before a British court—is so strong that some sort of temporary working arrangement between Arabian American Oil Co., Jersey Standard and Socony-Vacuum is expected to be announced any day now.

From other sources, close to the U. S. State Department and Department of Justice, it has been learned that considerable backstage support is being given the two American oil companies because of a fundamental belief by the U. S. Government that such restrictive arrangements as the Red Line Agreement are incompatible with international economic conditions today.

Moreover, reliable reports indicate that while the State Department—never actually having sanctioned the Red Line Agreement—may have figured that it was beneficial 25 years ago, this is not the position today and that for the past few years it has been waiting for the time when the restrictive clause might be washed out. The State Department takes considerable pride in the assistance given the petroleum industry of this country in the past, and there seems no doubt but what it will render similar assistance in the future.

As a matter of fact, the Red Line Agreement boomeranged on the I.P.C. partners before the current dispute arose, for prior to the war at least one of the partners wished to carry on additional oil-development work in Iraq on its own but was prevented from doing so because of the restrictive clause in the I.P.C. contract. The Iraq Government, moreover, also wished (and still does) to see more oil produced in Iraq as that meant more sorely needed royalties.

Nevertheless, the Government of Iraq obtained some of the needed money and eventually will get more royalties from greater production through an astute $12,000,000 interest-free wartime loan made from I.P.C. Conditions of this interest-free loan included the proviso that not one penny was to be repaid until Iraq's royalties were doubled from the then present crude-oil production. And to double the Government's royalties, construction of additional pipe-line facilities to the Mediterranean was the only answer. In fact, to bring the cost of crude per barrel into a competitive position in the Mediterranean, I.P.C. was forced to increase the pipe-line throughput, an activity which is being carried on today.

Meanwhile, Cie. Francaise, the I.P.C. partner formally protesting the arrangement whereby Jersey Standard and Socony-Vacuum would become respective 30 per cent and 10 per cent partners in Arabian American Oil Co., continues its negotiations in London with the I.P.C. board of directors, with the thought that possibly some advantage can be obtained if legal action is to be dropped. And it's certain that Cie. Francaise wants some sort of assurance that whatever Near East Development does, I.P.C. won't suffer.

Creole's January Production Reaches Record 585,715 Bbl. Daily

VENEZUELAN crude-oil production of Creole Petroleum Corp. reached a new high in January with an average daily production of 586,715 bbl. daily. This compares with 529,166 bbl. daily for December and 585,684 bbl. daily in October, the October output being the highest prior to January's production.

Creole's daily average production for week ending February 10 was 604,987 bbl.

Of the January output, 433,872 bbl. came from Lake Maracaibo area and Cumarebo and 152,843 bbl. from eastern Venezuela. Refinery throughput in January totaled 57,756 bbl. daily compared with 51,552 bbl. in December. Of the January total, 46,748 bbl. were refined at Caripito and 11,008 bbl. at La Salina.

Eighteen development wells and three wildcats were completed in January, all producers. The fields where the development wells were completed, their average initial production and depth follow:

Bolivar Coastal (B.C.F.), ten (including PB-176 erroneously reported as completed in December), 1,163 bbl., 3,595 ft.; Jusepin, three, 316 bbl., 4,529 ft.; Mulata, three, 526 bbl., 5,375 ft.; Quiriquire, one, 375 bbl., 3,780 ft.; and San Joaquin, one, 218 bbl., 5,053 ft.

The fields where wildcats were brought in, their average initial production and depth were:

Jusepin area, one, 493 bbl., 4,653 ft.; Quiriquire area, one, 147 bbl., 3,706 ft.; and San Joaquin, one, 963 bbl., 8,245 ft.

New Company Organized to Build Iran-Mediterranean Pipe Line

NEW YORK.—Plans are nearing completion for the organization by Standard Oil Co. (N. J.), Socony-Vacuum Oil Co., Inc., and Anglo-Iranian Oil Co., Ltd., of a new joint company to build and operate a crude-oil pipe line from Kuwait and Iran to the eastern Mediterranean coast.

Formation of the company, Middle East Pipe Lines, Ltd., is another step in carrying out an agreement by which the two American companies will buy upwards of 100,000 bbl. of crude daily from Anglo-Iranian (The Oil and Gas Journal, January 4, page 30).

Reports here were that the purchase agreement will not become effective until completion of the pipe line. The original announcement by the three companies of the purchase plan said the crude would be taken over a 10 to 20-year period.

Stock in Middle East Pipe Lines, Ltd., will be owned 50 per cent by Anglo-Iranian, 40 per cent by Jersey Standard, and 10 per cent by Socony-Vacuum. The project pipe line will be 26 to 30-in. diameter with a capacity of from 250,000 to 300,000 bbl. daily. Surveys are now being made to determine the best route of the $100,000,000 line.

Depending on the availability of the pipe, completion of the line is expected in 1950. A. C. Hartley, chief engineer of Anglo-Iranian, has been in Los Angeles recently inspecting facilities of Consolidated Steel Corp. in connection with plans for the fabrication of the pipe.

The Iran-Kuwait pipe-line project is separate from the Trans-Arabian Pipe Line Co., line in which Jersey Standard and Socony-Vacuum also will have an interest under the announced arrangement by which the two companies will buy an interest in Arabian American Oil Co.

The organization of Middle East Pipe Lines, Ltd., was disclosed with the arrival here of Sir William Frazer, chairman of Anglo-Iranian. He will confer with officials of American oil companies and speak before the anniversary meeting of the American Institute of Mining and Metallurgical Engineers opening here March 17.

Under present plans, the Iranian pipe line would meet a line from Kuwait at a point yet to be determined. A single line would be laid on to the Mediterranean. Anglo-Iranian is currently taking approximately 400,000 bbl. daily from the only producing concession in Iran; in Kuwait, Kuwait Oil Co., Ltd., jointly owned by Anglo-Iranian and a Gulf subsidiary, is producing some 40,000 bbl. daily from five wells in one field.

Work on Arabian Railroad to Start Soon

CONSTRUCTION of a railroad from Riyadh to Dammam, in Saudi Arabia, will get under way in a few months. This will tie in with the harbor-expansion plans at Dammam where the Arabian American Oil Co. will build the first modern port in that country. Currently, the Ras Tanura port is little more than an oil terminal, although cargo ships can unload there. Riyadh is the residence of King Ibn Saud.

Bechtel International Corp. states that an on-the-spot survey by the firm indicates construction costs will approximate $18,500,000, with total expenditures at the end of a 10-year period set at $20,500,000, taking into account maintenance expenses and anticipated revenues from the railroad.

The projected railroad, plans for which were initiated by King Saud, would cover 333 miles and would overcome such obstacles as the Abqaiq Sands and the Dahanas Sands, the former consisting of sand dunes as high as 60 ft. and the latter with dunes up to 100 ft. The Dahanas is a river of sand which is moving southwestward about 20 ft. a year and which connects the two great deserts of Saudi Arabia.

Travel time between Riyadh and Dammam now is 11 days, by camel caravans.

Other economic improvements, to be made shortly in Saudi Arabia—made possible because of the oil revenue paid to the government—are electrification of Riyadh and Jidda, the latter on the Red Sea.

Middle East Provides Most of French Crude

Sixty-two per cent of the 1,420,691 tons (about 10,000,000 bbl.) of crude oil imported by France during the first 7 months of 1946 originated in Middle East countries, according to the Office of Foreign Trade of the Department of Commerce. Of the remainder, 32 per cent came from Venezuela.

The United States shipped 63 per cent of the country's imported refined products, while most of the balance came from the Caribbean area. Imports of refined products during the period totaled 1,731,350 tons.

New U. S. Service Lists Foreign Products Buyers

Information on foreign firms desiring to purchase petroleum products is now being made available to American oil companies interested in the export market in a new service just started by the fuels and lubricants section of the Office of International Trade, Department of Commerce.

A monthly bulletin listing export opportunities will be sent to all firms requesting it, and additional information will be supplied on inquiry regarding the foreign firms seeking U. S. supplies.

International Exhibits Office Is Established

A new department which will encourage participation in international fairs and exhibits both in the United States and abroad has been established in the Office of International Trade of the Department of Commerce. Jacques Kunstenaar, former economic consultant in Zurich and New York, has been placed in charge of the department.

Fuel-Oil Department In Siam Is Abolished

The Government of Siam, following its announced policy of relinquishing its monopoly in the petroleum industry, has abolished its fuel-oil department, which handled petroleum products, according to information received by the Department of Commerce.

Civilian needs soon are expected to be filled by commercial companies which have been negotiating with the government for purchase of refining facilities and other installations. A new bureau has been created to handle government purchases exclusively. During the first 9 months of 1946, Siam imported petroleum products valued at $220,519 from the United States.

Drilling to Begin Soon on Gaza Well, First Test in Palestine

International

PREPARATIONS for the first oil well in Palestine are almost completed, and drilling is to begin in the late spring or early summer of this year, to be followed by another well as soon as possible. The operation is being carried out by Petroleum Development (Palestine), Ltd., a subsidiary of the Iraq Petroleum Co., Ltd. The tests will be the guide for future operations of this company which holds concessions in the coastal area and in the Negev (southern desert) of Palestine.

The first well will be drilled near Iraq Suweidan in the community of Huleiqat some 15 miles northeast of the Arab coastal town of Gaza. (Gaza is 40 miles south of the Port of Jaffa and 100 miles south of Haifa).

The geology of the Gaza well is obscure as the structure is barely visible from the surface features and its presence was revealed as a result of geophysical methods. In the first instance a torsion-balance survey was run over the area, and this survey was checked immediately before the outbreak of war in 1939 with a gravity-meter survey, which gave encouraging evidence that the subsurface structure was present. In order to check these geophysical methods, a seismic survey was conducted in the summer of 1946, and this survey resulted in selecting a suitable drilling site based on geological and geophysical evidence. The Huleiqat site will be subjected to a thorough test and it is anticipated the well will go some 10,000 ft. deep unless oil is encountered at a shallower depth. Any successful discovery here would be a great tribute to geophysical methods of exploration, although the meager surface geology was initially responsible for the selection of the area as having oil possibilities.

Present operations on the site include the erection of the derrick and the assembly and installation of drilling equipment. Headquarters for the field operations of Petroleum Development (Palestine) have been established at Gaza where offices, stores and sheds were set up in preparation for a complete organization to make the test as thorough an operation as possible. A large part of the equipment to be used has been shipped to Palestine from Britain, while certain accessories have been secured in the United States.

The second well will be in the Kurnub area in the Negev, 50 miles south of Jerusalem and 20 miles west of the southern end of the Dead Sea. In relation to Huleiqat this field is situated 45 miles southeast of Gaza. Drilling in Kurnub will start some what later than at Huleiqat, due to the extensive road construction necessary to connect the field with the existing track leading from the Dead Sea to Aqaba on the Red Sea. There will also be extensive camp construction and road building required over very rough mountainous terrain. Another major problem in that area is the shortage of water for drilling purposes, but it is expected that this difficulty will shortly be overcome.

Kurnub Geology Different

Geological conditions at Kurnub are somewhat different from those at Huleiqat. Kurnub is a well-defined surface structure and does not require geophysical methods. The stratigraphic horizons to be tested will be lower geologically than in Huleiqat.

Although the oil possibilities of Palestine are scracely comparable to some of the proven productive areas in the Middle East, geologists and geophysicists recognize that essential geologic factors for the accumulation of oil exist and therefore justify drilling which involves considerable expenditure. In case of discovery of commercial quantities of oil in the Holy Land, the proxmity of the Mediterranean seaboard will of course be a compensating factor to high development costs.

Laws governing the exploration of Palestine's oil resources, as summarized in the Palestine Government report to the Anglo-American Commission a year ago contain time-limit clauses in the interests of genuine and expeditious development, affecting the commencement of work and expiration of the concession. At the end of the concession all rights revert to the government, and all leases of state-domain lands specify the right of the government to resume possession of the area for public-utility purposes. In 1938 a special ordinance governing prospecting for and mining of oil was enacted, prohibiting operations except under prospecting licenses or mining leases, and making provisions for the right of preemption of oil by the government in the event of grave emergency.

Apart from the concessions in the coastal area and in the Negev, which are in the hands of Petroleum Development (Palestine), prospecting licenses were also given to Jordan Exploration Co., Ltd., in the area around Jebel Uzdum (Mount Sodom) at the southern tip of the Dead Sea. The preliminary surveys conducted in all three areas before the war came to a standstill at the end of 1939 owing to shortage of manpower and materials and the uncertain military development in the Middle East.

Prospects for future operations in Palestine are summed up in the Government survey, which states: "It yet remains to be proved whether oil exists in commercial quantities in Palestine. Apart from small bitumen occurrences in the Jebel area there is no direct evidence of the existence of oil, although a number of geological structures exist that might prove to be oil bearing. . . . Owing to difficulties in geological conditions, no direct comparisons can be made between Palestine and the oil-bearing regions of the Middle East, and any attempt to assess oil prospects in Palestine must therefore be very speculative."

Production in Venezuela Shows 20 Per Cent Gain

Production of 388,000,000 bbl. of crude oil in Venezuela in 1946, according to preliminary estimates published by the Office of International Trade of the Department of Commerce, indicates an increase of 20 per cent over 1945's production figure.

Production rose from a daily average of 979,094 bbl. in January to a peak of 1,120,051 in November, but dropped to 1,089,298 in December because of a lack of market for the oil.

The country's producing potential increased from 1,072,240 bbl. daily in January to 1,173,320 in December. During the first 11 months of 1946 the output of refined products totaled 32,225,249 bbl., of which 24,672,329 bbl. were exported.

Of the 651 wells completed during the past year, 562 were oil producers, 7 were gas wells, and 82 dry holes.

Herridge Named I.P.C. Near East Manager

G. H. Herridge, formerly assistant general manager oin the Near East for Iraq Petroleum Co., Ltd., has been made general manager at the Haifa, Palestine, general offices.

He succeeds M. M. Stuckey, well-known Middle East oil official who died January 29 in Haifa.

Bids Asked for Construction of Argentine Gas Pipe Line

BIDS to construct the projected 1,100-mile natural-gas pipe line from Argentina's Comodoro Rivadavia fields to Buenos Aires are being sought from firms in the United States by the Argentine States Gas Service Department (Direccion General del Gas del Estado, Secretaria de Industria y Comercio), according to the American Embassy at Buenos Aires and the current Foreign Commerce Weekly.

This is one of Argentina's projects under a 5-year-plan and will cost an estimated 100,000,000 pesos ($25,000,000). Work to be covered by tender involves ditching, welding, coating and wrapping, testing, and valves. Quotations reportedly must include a general estimate for complete construction of each 1,000 m. of pipe in accordance with specifications, as well as separate estimates for each of the four separate sections in which the construction work is divided.

Equipment needed to execute the contract will be exempt from import duty, with the Direccion General del Gas del Estado assuming responsibility for obtaining the necessary permits. Such equipment will become the property of the Direccion General upon completion of the work.

Two copies of specifications are available for examination on a loan basis from the technology and construction section, Office of International Trade, Department of Commerce, Washington 25. Bid forms should be requested direct from the Direccion General in Buenos Aires, while complete information concerning entry of bids may be obtained from the technological bureau, Maipu 241, fourth floor, Buenos Aires.

(For additional details, see The Oil and Gas Journal, February 8, page 44, and February 15, page 61.)

November Anglo-Iranian Production Increases

Anglo-Iranian Oil Co., Ltd.'s crude-oil production in Iran for last November totaled 1,689,000 tons (12,498,600 bbl.), or approximately 417,000 bbl. daily. This compares with 1,520,000 tons (10,640,000 bbl.), or approximately 343,000 bbl. daily, for October.

Total Iranian production from January 1 through November 30, 1946, was 17,505,000 tons (129,537,000 bbl.), or approximately 387,000 bbl. daily.

Guatemalan Assembly To Consider Oil Law

Sometime in March the Guatemalan Assembly is expected to consider passage of the proposed Guatemalan oil law written last year by Max W. Thornburg, U. S. consultant on foreign oil. Sources in Guatemala and the United States indicate that the chances for approval are excellent.

However, before foreign capital will be permitted to enter Guatemala, other than as a minority interest in a company, the Guatemala Constitution must be amended. The president of Guatemala believes that approval of the oil law first is the best procedure, after which efforts will be made to amend the constitution. (For more details, see The Oil and Gas Journal, October 12, 1946, page 60).

Iceland Government Buys Wartime U. S. Fuel Depot

WASHINGTON.—Sale of the wartime Navy fuel depot at Hvelfjordur, Iceland, to the Icelandic Government for approximately $309,000 has been announced by the Office of the Foreign Liquidation Commissioner.

Disposal of the property, which has a declared cost of $6,000,000, was in keeping with the U. S. policy of offering such types of surplus to the government where the property is located, according to the announcement. Facilities purchased by Iceland consisted of 42 storage tanks for fuel and gasoline ranging in capacity from 10,000 bbl. to 35,000 bbl. each; about 70 Quonset huts; a pier, all auxiliary equipment, two tenders, and a 900-ton tanker. Previously 10 storage tanks of 10,000-bbl. capacity had been sold piecemeal to local buyers for removal and use in Iceland.

Harry A. Gibbon Named N.K.P.M. General Manager

Harry A. Gibbon and Albert Wright, Jr., have been appointed general manager and assistant general manager, respectively, of Nederlandsche Kolonial Petroleum Mij., L. W. Elliott, president of Standard-Vacuum Oil Co. has announced. N.K.P.M. is the Netherlands Indies' subsidiary of Standard-Vacuum.

Gibbon is a graduate of Rice University. After working for Humble Oil & Refining Co. he joined Standard-Vacuum in 1939. After the war he was transferred to N.K.P.M. and went to Batavia, Java, after the Japanese surrender made it possible to start postwar rehabilitation planning of the company's refinery and oilfield properties in Sumatra.

Wright, who has specialized in production work, joined N.K.P.M. in 1938 after 14 years in the oil fields of Venezuela and the Middle East. He has been production manager of N.K.P.M. and until recently was temporarily assigned to that company's headquarters at The Hague. Born in Havana, Cuba, Wright is a geology graduate of Harvard University.

Both men will be headquartered in the Netherlands East Indies.

Pemex Steps Up Output From Isthmus Fields

MEXICO CITY. — Daily crude-oil output from Mexico's 15 small fields centered around the Minatitlan refinery in Puerto Mexico, has been increased from 12,000 to 17,000 bbl., according to Antonio J. Bermudez, director general of Petroleos Mexicanos (Government Oil Administration).

Bermudez indicated that production here is expected to be increased even greater in 1947 as this year's exploration program calls for nine wildcats in the Isthmus district. Currently six rigs are engaged in development work, three in wildcatting and one on rehabilitation work.

Less than 25 wells in the Isthmus region are flowing. This is the only region in Mexico where artificial lifting is done. Three natural-gasoline plants are in operation here, although their throughput has been greatly curtailed. Bermudez is optimistic about natural-gas development, partially due to increased production expected in Mexico and because of the plans to import certain quantities by pipe line from the United States.

Brazil's December Crude Output Set at 6,233 Bbl.

December crude production in Brazil totaled 6,223 bbl., of which 5,862 bbl. was from Candeias field, according to the Office of International Trade of the Department of Commerce.

Of the two wells completed in that field in October, one was abandoned at 5,483 ft. as a dry hole. The other flowed 1,032 bbl. of oil through a ¾-in. choke during the first 24-hour test. It was drilled to 2,585 ft.

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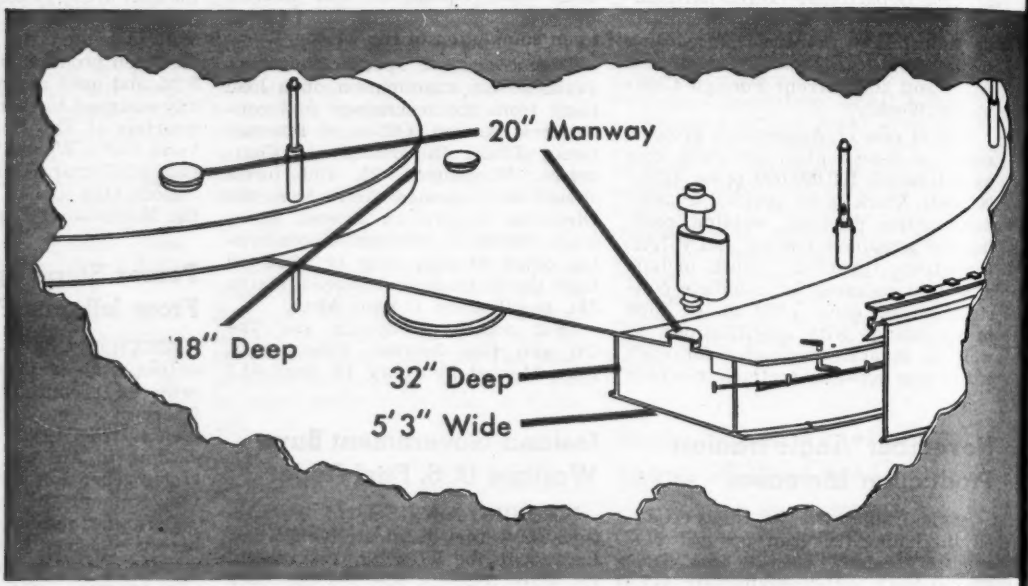

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WIGGINS GATX GENERAL AMERICAN VAPOR SEALS

Wider Adoption, Closer Study Urged For Secondary Recovery in Texas

by George Weber

WICHITA FALLS, Tex.—The growing importance of secondary recovery in our domestic oil economy and the practical aspects of furthering successfully such practices in Texas were thoroughly discussed here March 8 at the annual secondary-recovery session conducted by the North Texas Oil and Gas Association.

Before a group of 246 operators and engineers from all parts of the country, Paul D. Torrey, consulting petroleum engineer of Houston, opened the session with an outline of a plan for increasing oil recovery in Texas. He declared the problem as two-fold, not only requiring correction of past mistakes made in primary production methods but also demanding prevention of those same mistakes in current and future production practices in flowing fields. Pointing out that Texas, with a vast potential of flush production had lagged in following the precedent set by other states where concerted attention has been given declining fields, he declared that the industry in that state still had time to make long range plans for research in secondary recovery as it applied specifically to Texas problems. As leaders in this proposed program, he suggested the various oil associations and the state Railroad Commission, working in conjunction with national agencies such as the Bureau of Mines and the Interstate Oil Compact Commission.

As a basis for a state-wide program for promoting secondary recovery, he recommended a complete survey of all fields which are now, and may in the future become secondary-recovery prospects. Considering the methods of primary production employed and the characteristics of the individual fields, such a survey would not only draw attention to good prospects but would eliminate poor ones, thus saving operators the effort and expense of attempting present known methods in fields where they would prove uneconomical. Such a survey, followed by application of practices evolved from a state-wide research program could presumably double recoverable reserves in the state, he predicted.

Unit Operation Asked

Operators were warned not only to look back to fields where early mistakes were made, but to employ practices in newer fields which will prolong flowing life and render unnecessary the expensive secondary-recovery methods now required as corrective measures in poorly produced fields. In that respect he particularly recommended for immediate consideration in developing oil fields, the following: Proper spacing and well completion to facilitate gas injection or water flood; strict gas conservation to maintain reservoir energy and oil fluidity; and unitization of oil properties. Unit operation on a field-wide basis he decared most important, since some of the most promising secondary-recovery prospects in the state will not be feasible unless conducted on a field-unit basis.

Endorsing Torrey's remarks, William J. Murray, Jr., Texas' new railroad commissioner stated his personal opinion on three ways that the state body should assist in obtaining added oil recovery for Texas: By pioneering with the industry, by cooperating with the industry, and by urging the industry to follow the best practices possible to recover more oil economically. If the facilities are made available and the industry agrees, he advanced the opinion that the commission should engage in actual research on secondary recovery. Although the commission is in a position to aid the program by assembling case histories on fields, evaluating results of various practices, and pointing out good secondary-recovery prospects, he feels that it should not confine its actions merely to policing and looking backward, but should pioneer at least as much as state agencies have done in Arkansas, Pennsylvania, and other oil states.

Practical Applications

Four water-flood projects under way in North Texas and Kansas were described in detail by H. M. McClain, petroleum engineer with Magnolia Petroleum Co., Dallas. This practical discussion of selected cases revealed that although all are still in the development stage, present indications point to success in all four projects. He concluded, on the basis of the leases concerned, that better results were indicated where slower water injection rates were used and where wider spacing (20-acre pattern, vs. 10-acre pattern) was used. He warned, however, against enthusiastic acceptance of this practice without a thorough previous study of each individual water-flood prospect. He also recommended that the water flood plan for a lease or a field provide for initial water injection in all such wells simultaneously to give more uniform flushing and greater recovery.

Installation and operating costs should be most carefully studied,

Participating in the forum discussion on secondary recovery were, left to right: Roland Gouldy, Bridwell Oil Co., Wichita Falls, who presided at the session; Dr. George H. Fancher, University of Texas; Paul D. Torrey, consulting petroleum engineer, Houston; R. K. Guthrie and D. B. Taliaferro, Bureau of Mines, Wichita Falls; Gordon Stine and Jo H. Cable, Cable & Stine, Wichita Falls; James Nash, Reno Oil Co., Wichita Falls; H. M. McClain, Magnolia Petroleum Co., Dallas; W. H. Rouzer, KMA Pressure Maintenance Association, Wichita Falls; and David Dean, Dean Brothers, Fort Worth

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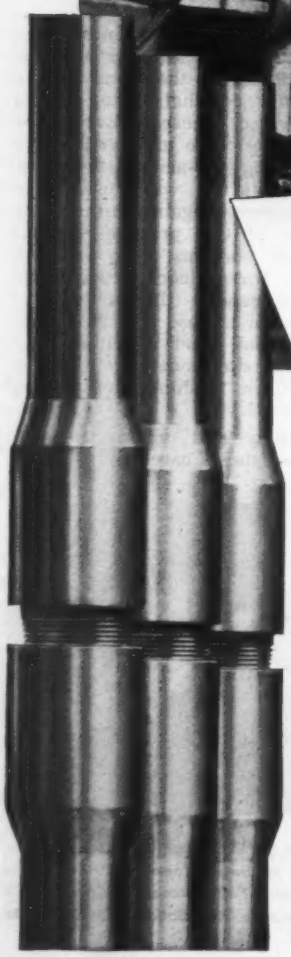

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New and retiring officers of the North Texas Oil and Gas Association include, left to right: E. B. Clark, independent, outgoing vice president; J. P. Coleman, McCarty & Coleman, retiring president; J. H. S. Bonner, independent, new president; G. W. Dimock, Akin & Dimock, new vice president; and Fred Sehmann, executive vice president, all of Wichita Falls

since such prospects must be not only sound from an engineering standpoint, but must also prove economically practical. Since water flooding in North Texas often requires close cooperation between offset operators, he stated that unitization might be necessary in many cases for the recovery program to pay out.

The use of a newly developed resin in selective plugging of water input wells was described by Don Martin, Hercules Powder Co., Wilmington, Del. Selective plugging tests performed with this product in Bradford field of Pennsylvania have resulted in greatly reduced water input, without visibly reducing oil production, thus cutting water-flood operational costs.

A comprehensive report dealing with the case histories of 11 selected water-flood projects in seven North Texas counties, prepared by D. B. Taliaferro and R. K. Guthrie of the Bureau of Mines' Wichita Falls substation, showed wide variations in practices and results, further underscoring the need for thorough investigation of each project on its individual merits before attempting water flood.

Forum a Success

The meeting concluded with an open forum during which questions from the floor were answered by a panel of engineers led by Jo H. Cable, the association's chairman of the secondary-recovery committee. This feature, which will be continued at next year's meeting, has gained considerable reputation by bringing out aspects of secondary recovery not always covered in prepared papers and by providing a clearing house for opinion on a broad base.

In summary, opinions expressed during this session showed that Texas water-flood prospects cannot be treated like those in other states where sand sections are generally thicker. Consequently, the profit margin in North and West Central Texas is comparatively slim, and operators must resort to wider spacing to reduce installation costs, and improved lifting methods to keep operating costs in line. Five-spot flooding is considered the best method, excepting in small, regular, and unitized fields. Flooding to pressures which will facilitate flowing production wells instead of pumping them may prove best in some fields.

Unitization was stressed again as an unqualified "must" for greater oil recovery through secondary means in Texas. The consensus also showed that the recent increases in the price of oil have not kept pace with the rise in water-flooding costs, therefore prospects for new projects in North Texas are not as bright today as they were 3 or 4 years ago.

The secondary-recovery meeting coincided with the association's seventeenth annual meeting, at which new officers for 1947 were installed. At the annual banquet, 571 members and guests heard Max W. Ball of the Oil and Gas Division, Department of the Interior, reassure the industry regarding his agency's intentions. He stated that "the Oil and Gas Division has no power to direct the industry or anyone in it. It does not want such power. Except in time of national emergency, it should not have such power."

Maritime Commission Sells 20 More Surplus Tankers

A total of 20 surplus tankers, all but two of the T-2 type, were delivered to new owners by the U. S. Maritime Commission during January under the Surplus Ship Sales Act.

To date the commission has sold 938 ships of all types including 53 tankers to American operators and 50 tankers to foreign governments and operators. The latest announcement lists the following tanker sales:

Anglo-American Oil Co., three T-2; Imperial Oil, Ltd., one T-2; The Texas Co., two T-2; Overseas Tankship, two T-2; Tide Water Associated Oil Co., two T-2; Norwegian Government, one T-2; Skibsaktieselskapet Ferm (to Norwegian registry), one T-2; American Trading & Production Corp., one T-2; Sun Oil Co., one T3-M-AZ1; Oriental Trade & Transport Co., two T-2; Gulf Oil Co., one T-2; Skibsaksjeselskapet Preba (to Norwegian registry), one T-2; Richfield Oil Co., one T3-S-A1; and Cities Service Oil Co., one T-2.

In its report, the Maritime Commission also listed the sale of a cargo vessel, C1A (S) to Warren Maritime Corp. (See The Oil and Gas Journal, January 18, page 37).

Fellowships Announced By Two Oil Companies

Appropriation of $20,000 to establish 10 annual fellowships in chemistry and physics at leading educational institutions was announced last week by Socony-Vacuum Oil Co., Inc. B. Brewster Jennings, president, said recipients will be students with at least 1 year of graduate work.

In Canada, Imperial Oil, Ltd., announced it again this year is offering four research fellowships, each valued at $3,000. They are open to graduates of Canadian universities for work leading to a doctor's or master's degree in petroleum and chemical fields.

Water Flooding Started In Oklahoma Pool

Water-flooding operations have been started in the Allen pool, Pontotoc County, Oklahoma, by Hill & Hill and K. B. Nowels of Allen, Okla.

Authority has been given to drill six injection wells and one water well. The Allen sand at 780 ft. will be flooded. The initial project will flood a 160-acre tract on which there are eight stripper wells making a combined production of 3.4 bbl. per day.

MER Hearings Set

AUSTIN.—The Texas Railroad Commission has set the following dates for hearings to determine the maximum efficiency rates of oil fields, by districts: May 2, District 2; May 6, District 3; May 8, District 4; May 13, District 5; May 14, District 6; May 15, Districts 7-B and 7-C; May 20, District 8; and May 23, Districts 9 and 10.

Gasoline Plant Being Built

Construction last week was under way on a $3,000,000 natural-gasoline plant about 15 miles northeast of Refugio, Tex. The plant is being built jointly by Humble Oil & Refining Co. and Quintana Gas Co. It is scheduled for completion late this autumn.

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WASHINGTON WATCHING

BY HENRY D. RALPH

Rizley-Bill Hearings

WASHINGTON.—Early hearings on the Rizley bill to amend the Natural Gas Act have been assured by the House committee on interstate and foreign commerce as a result of a personal plea by the bill's author, Rep. Ross Rizley of Oklahoma.

Though not a member of the committee, Rizley appeared before it and put up such a good case that the committee immediately scheduled hearings for March 18. However, gas-industry representatives were not prepared for such prompt action and asked a little more time to line up witnesses, so the hearings have tentatively been rescheduled for April 14 and 15.

Rizley told the committee that nobody in the gas industry knows how to operate under the law because the Federal Power Commission and the courts have extended its coverage far beyond the intent of Congress, and as a result many gas fields are lying undeveloped while consumers are badly in need of gas. He declared his bill does nothing but restate in more explicit language the intent of Congress when the law was written originally, but that it is necessary to offset the "usurpation" of authority by FPC.

As justification for the legislation Rizley quoted the statement made by Chairman Nelson Lee Smith of FPC at the opening of the natural-gas investigation hearings in Kansas City, last year, in which the chairman said it is desirable for an administrative agency to pause and appraise its actions and to evaluate its policies and the soundness of its interpretations.

The chief reason for the committee's eagerness to undertake a major revision of the Natural Gas Act probably is the prevailing desire to curtail the powers of nearly all federal regulatory agencies, permanent as well as temporary. If this spirit continues it is possible that the bill might romp through both Houses of Congress during the current session. However, if much opposition develops it is more likely that the measure will get delayed so that Senate action could not be obtained before the end of this session, now talked of as around July 1.

Inch-Sale Preliminaries

AN interim lease to provide continued use of the Big Inch pipe lines for natural gas is currently being negotiated between War Assets Administration and Texas Eastern Transmission Corp.

Texas Eastern, on February 28, accepted the letter of intent from WAA outlining the terms of the contract of sale for $143,127,000 and of an interim lease to take effect April 30 at the expiration of the present lease of Tennessee Gas & Transmission Co. This lease is to be on the same rental and terms as the T.G.&T. lease, unless additional provisions are mutually agreed, and Texas Eastern must make an application to the Federal Power Commission for a temporary certificate to continue the operation. The FPC's Big Inch advisory committee last week recommended a schedule for allocating among distributing companies in the Appalachian area the natural gas now being put through the lines by T.G.& T. and urged FPC to take necessary action to have this movement continued after April 30 without interruption. (See page 119).

The interm lease to Texas Eastern may remain in effect for a good many months before the sale is finally consummated. First the Government must perfect the right-of-way by completing a large number of miscellaneous land condemnation suits, while the corporation must obtain a permanent certificate from FPC, obtain necessary easements for gas transmission, and complete its financing.

Tank-Truck Regulation

A CHAIR company in North Carolina has given a case of jitters to the entire trucking industry and particularly operators of oil tank trucks. The outcome of its case now pending before the Interstate Commerce Commission may determine whether or not oil companies can deliver gasoline to filling stations without being licensed as common or contract carriers.

It seems that Lenoir Chair Co. brings lumber to its plant in its own trucks and sometimes these trucks take a load of chairs to a customer on the outbound trip. An ICC inspector challenged its right to make deliveries, taking the position that it was acting as a "for hire" carrier though not licensed to do so. Hearings were held and the ICC examiner recommended that the commission find that the Lenoir company "was primarily engaged in a bona fide noncarrier business, and that the transportation performed was incidental to and in furtherance of such noncarrier business, without any purpose of profit from the transportation of such."

However, the Regular Common Carrier Conference and the National Tank Truck Carriers, Inc., have intervened to ask the ICC to reverse its examiner and to rule that this type of transportation makes the company a "for hire" carrier. Both these organizations are branches of the American Trucking Associations, and a third branch of A.T.A., the Private Carrier Conference, has intervened to support the position of the chair company.

The National Tank Truck Carriers includes for-hire common and contract operators of tank trucks not affiliated with oil companies, while the Private Carrier Conference includes many oil companies operating their own tank trucks. The latter group contends that if the Lenoir Chair Co. loses its case the way will be open for the ICC to classify nearly all oil trucking operations as "for hire." This would require oil companies to obtain ICC certificates of public convenience and necessity and to file rates and tariffs subject to the approval of the commission whenever deliveries are made to a customer.

Industry Statistics

THE necessity for better statistics on availability and reserves of petroleum throughout the world proved to be the chief bone of contention at the meeting of the statistical-advisory committee of the National Petroleum Council last week.

The committee met for 3 days discussing various aspects of government and industry statistics relating to the oil and gas industries. As a starter it had a survey made by various government agencies showing what statistics are now available and what additional ones the agencies would like to have. The general disposition was to offer industry assistance in collecting statistics and to point out what data are needed for industry operations, and the committee may recommend that the Oil and Gas Division compile a summary of all statistics regularly gathered by industry and government agencies and circulate it for review and comment to obtain views on what is missing and what is unnecessary.

However, there was considerable opposition to furnishing the Government with figures of individual companies on their underground reserves

and availability for production, particularly in foreign countries. Director Max Ball of OGD did his best to overcome this opposition by pointing out that he is constantly being asked questions which can be answered only by reference to information on availability and reserves. He declared that the Government will have to obtain such statistics itself in one way or another in order to determine policies on such matters as development of the Continental Shelf, the synthetic-fuels program, imports, and preservation of stripper wells. Final decision of the committee probably will not be known until the next meeting of the council April 22.

Surplus-Refinery Survey

AN important new approach to the disposition of surplus 100-octane refineries has been adopted by the War Assets Administration in the employment of the Ralph M. Parsons Co. of Los Angeles to make a survey of all government refining equipment yet unsold.

The company's assignment is not to make a physical inventory but an economic appraisal of the "fair value" of the plants both to their wartime operators who are the most likely bidders and to the petroleum and chemical industries as a whole. The objective is to prevent the former operators from obtaining windfalls by purchasing the equipment so cheaply as to give them an unfair advantage over competitors. The company is asked to recommend dismantling of plants and sale of equipment piecemeal in all cases where bids for use in place are considered below the economic fair value.

In recent months there has been considerable interest in purchasing the 100-octane facilities, due partly to the current difficulties of obtaining new refining equipment but more to a realization that an "octane race" is coming and successful refiners must have modern equipment. A number of companies considering the construction of new catalytic crackers are hesitant to make the required investment until they know whether or not competitors are going to be able to purchase surplus government plants at very low figures. WAA hopes to give the industry confidence that it will not make any windfall sales in spite of its desire to dispose of the properties as quickly as possible.

The Parsons survey will deal not only with the properties themselves, but with external factors such as markets, availability of raw materials, dependence of the plant on other types of operations, and suitability of the equipment to conversion for use by other companies in either the petroleum or the chemical industries.

Following this survey, which is to be completed in about 90 days, WAA may set a minimum price for each facility.

A Welcome Refrain

DIRECTOR MAX W. BALL of the Oil and Gas Division is currently a one-speech man by popular demand. The versatile and imaginative Max has plenty of other speeches up his sleeve, but his oil-men audiences insist on their favorite — what the Government is not going to do to the oil industry.

He put himself on record when he took the job and has repeated it on several occasions. But his friends say that is not enough, that all oil men should hear the gospel directly from his lips. So, with a few apologies for not having prepared something new, Max is going around the country addressing oil groups on how the Oil and Gas Division is going to keep the Government out of the industry's hair instead of fostering more regulation and interference. After some 15 years of various kinds of government control and threats of more to come, Max's message can well stand considerable repetition.

Retailers for NPC

THE Oil and Gas Division has set a deadline of April 1 for nominations for one or two additional appointees to the National Petroleum Council to represent independent retailers.

In spite of criticisms that the council membership as originally constituted failed to give adequate representation to this branch of the industry, nominations have been slow in arriving, and there is little unanimity among those suggesting names. This is probably due to the fact that retailing is a local business and outstanding independent retailers who are capable of contributing to the work of NPC are not widely known outside of their own states. For this reason the OGD has postponed making appointments while attempting to obtain nominations from retailers in various parts of the country.

FPC Staff Report

FIRST reaction to the Federal Power Commission report denying itself any jurisdiction over production and gathering of natural gas or sale of gas for interstate transmission is that the commission is simply trying to prevent passage of the Rizley bill to do this very thing by law.

There is good reason to believe that the report would not have been pushed out quite so fast if legislation had not been introduced, but that the commission's staff would have reached the same conclusions in any event. The unanimity and emphasis of the oil and gas industry and of the state commissions on this point was one of the outstanding features of the natural-gas investigation. It should have been obvious that if the commission or the courts should finally conclude that FPC does have jurisdiction over this phase of the gas business there most certainly would be an effort to amend the act sooner or later.

The Rizley bill of course, contains other things besides a denial of jurisdiction over production and gathering, so the commission's report on this phase does not remove the need for new legislation. However, it is probable that the industry will insist that Congress backstop the commission's interpretation of the law by more specific clarification just to make sure that some future group of FPC commissioners or some federal courts do not make any more mistakes.

A Legal Field Day

THE argument of the tidelands oil case before the Supreme Court this week covered a vast range of legal and historical lore about the boundaries of states and nations and jurisdiction over the beds of oceans, rivers, and bays, with only passing references to the crux of the case—whether the federal or the state governments shall control and collect royalties from oil leases off the coasts of California, Texas, and Louisiana.

Since California's title is being directly attacked in this case, its attorney general bore the burden of the defense. But because the Government's suit is interpreted as a claim on the submerged lands of all coastal states, a vigorous defense was entered by the National Association of Attorneys General, with the chief legal officers of Texas and Louisiana participating in writing the brief.

The bulk of the argument was a series of citations of maritime, federal, state, international, Spanish, English, and common law, and court decisions thereunder, to show that the U. S. Government doesn't have a shadow of a claim to the marginal sea below the low-tide mark.

However, the brief for the attorneys general made much of the point that the Department of Justice has not been able to define what it is claiming, such as the distinction between inland and coastal waters, or what constitutes a bay, or whether the low-tide mark should be the present one or what it was when the state was admitted to the Union. If the Government wins this case, the attorneys general declared, it will disturb an established rule of property rights and require hundreds of subsequent Supreme Court decisions to determine the boundaries of many bays—including some in California and the Gulf Coast from which oil is being produced—and the ownership of piers, wharfs, filled land, fisheries, and many other properties.

Crude Advance Stiffens Already Tight Products Market

THE announcement of Standard Oil Co. (Ind.) of a general 25-cent crude-oil price increase early this week gave additional momentum to the already upward movement of products prices.

Further increases in prices of many products, particularly motor fuel, were expected to follow the advance in crude postings (see page 54). Marketing officials were anticipating Midwestern and Mid-Continent gasoline to rise to at least 7½ cents, tank car, Group 3. Present prices range from 7 to 7⅜ cents.

Products prices throughout the country generally were moving to higher levels before the crude-advance announcement. Gasoline prices were raised last week along the Eastern Seaboard.

In Oklahoma and North Texas, gasoline prices started upward immediately in response to the crude advance. Anderson-Prichard Refining Corp. and Mercury Refining Co., both Oklahoma City, hiked refined products in tank-car lots effective immediately. Anderson-Prichard's new quotations raised premium-grade gasoline 1 cent and other grades ¾ cent. Kerosene prices were increased 1⅛ cents and range oils generally 1 cent.

A shortage of material, made more acute by a lack of tank cars, continued to hamper market operations in the Mid-Continent and Midwest.

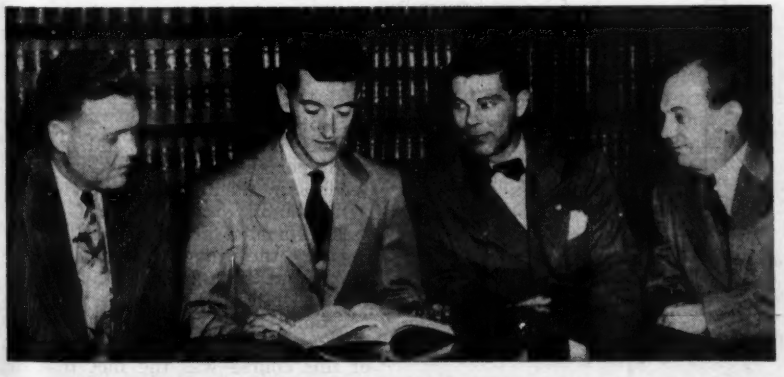
Though the normal heating-oil season is near its end, this group of products continued in heavy demand. Northern jobbers were actively searching Mid-Continent and Midwestern suppliers for material. Some No. 2 and other distillates were moving from Gulf Coast plants into northern marketing territory, despite higher freight costs. Suppliers reported selling No. 2 at prices ranging up to 5½ cents.

Kerosene was bringing a full 6 cents in many transactions. Spot-market residual fuel oil was reported selling at prices up to $1.60 per barrel. One major buyer said last week he had been unable to find pipe-line gasoline even at ⅜ cent over the prevailing market price.

While the crude advance came earlier than many sales officials expected, it had been forecast for weeks. An increasing number of contracts for products have carried clauses providing adjustments in case of an increase in crude postings.

Another bullish influence in the market was the release of the Bureau of Mines demand forecast for crude oil for March. The bureau said total demand for all oils in the first quarter of 1947 may exceed its original forecast by at least 2 per cent. March domestic crude demand was placed at 4,745,000 bbl. daily. Motor fuel demand for the first quarter was revised to a total of 177,000,000 bbl., about 3½ per cent over the original forecast.

In the East, other major suppliers were following the action of Standard Oil Co. of New Jersey in posting higher gasoline and kerosene prices. Socony-Vacuum Oil Co., Inc., raised kerosene prices from 0.1 to 0.2 cent in most of New York and New England and also announced an increase of 0.3 to 0.4 cent for regular gasoline at many points. Atlantic Refining Co. boosted gasoline and kerosene 0.2 to 0.6 cent in many localities.



New officers of the Petroleum Engineers Club of Fort Worth include the group above: W. A. Moncriet, Jr., secretary-treasurer; Meyer Dubrow, Continental Oil Co., president; E. D. Brockett, Gulf Oil Corp., vice president in charge of membership; and Jake C. Knoll, Bethlehem Steel Co., vice president in charge of entertainment. Not shown is Charles Pishny, vice president in charge of programs

Bid Date Extended

Closing date for acceptance of bids on equipment and facilities in the Canol-1 project has been extended from March 20 to April 21, according to an announcement by the Office of the Foreign Liquidation Commissioner.

DEATHS

John Ralph Platko, 47, Bradford, Pa., drilling contractor, died March 3 in a Bradford hospital.

William T. Herrick, 75, retired oil broker and former drilling superintendent for Marland Oil Co., died March 5 in Tulsa.

Fred G. Yonker, 67, superintendent, Chestnut Smith Oil Refining Co., Ranger, Tex., died March 2. Yonker was born in Berne, Switzerland, and came to this country in 1892. He had been with the Chestnut Smith company since 1919.

Robert Gregory Myers, independent operator, died March 3 in a Houston hospital.

Louis Henry Wellensiek, 59, engineer with Hughes Tool Co., died March 2 in a Houston hospital.

Walter Blumenthal, manager of Raven Oil Co., Ltd., since 1944, died recently in England.

J. Earle Freeman, 50, oil and gas operator of Houston, died in Cleveland, Tex., March 5 from injuries received in an automobile accident.

Herbert T. Morian, 98, who paid 25 cents for a pint of oil from the Drake well the day after it came in, died March 4 at his home in Bradford, Pa. He entered the oil business near Bradford at the age of 12 as a driller. In 1916 he aided in the development of Salt Creek field in Wyoming and in 1927 was awarded a distinguished-service medal at the International Petroleum Exposition in Tulsa.

L. V. Patterson, plant engineer with Southern California Gas Co., died recently in Santa Fe, Calif.

D. C. Kennedy, 52, Texas Panhandle district manager for Bovaird Supply Co., died recently in Pampa, Tex. Associated with the oil industry his entire life, Kennedy was with Atlas Supply Co. before World War I and joined Bovaird upon leaving military service.

Manufacture of Synthetic Gasoline Nearing Commercial Application in U. S.

by George Roberts, Jr.,* and J. A. Phinney†

THE manufacture of synthetic gasoline currently under development is rapidly nearing commercial application in this country. This process, derived from the German Fischer-Tropsch process and variously designated the Synthol process, the Synthine process, and the Hydrocol process, has been described extensively in recent periodicals from the standpoint of the chemistry and process features involved. This paper will outline the engineering aspects of the commercial synthetic gasoline plants in Germany and of the proposed plants in the United States.

It is of interest to consider the engineering involved in the construction of the German synthesis-reaction chambers. The design of a synthesis reactor presents, primarily, a problem in close temperature control as well as provisions for heat removal. The synthesis reaction is quite highly exothermic, and the removal of large quantities of heat per unit of reaction chamber volume is therefore required. In addition, the synthesis reaction is quite sensitive to temperature, and very close control of temperature is believed necessary to avoid the formation of undesirable byproducts. Two types of synthesis reactors were employed by the Germans, one designed for atmospheric pressure operation and the other for operation at approximately 100 psi. The catalyst was preformed, and because of the low heat conductivity of this catalytic material, the reactors were necessarily designed with very small distances between catalyst particles and cooling surfaces.

*Manager, research department, and †research group supervisor, Stanolind Oil & Gas Co. A paper presented at the A.S.M.E. spring meeting, Tulsa.

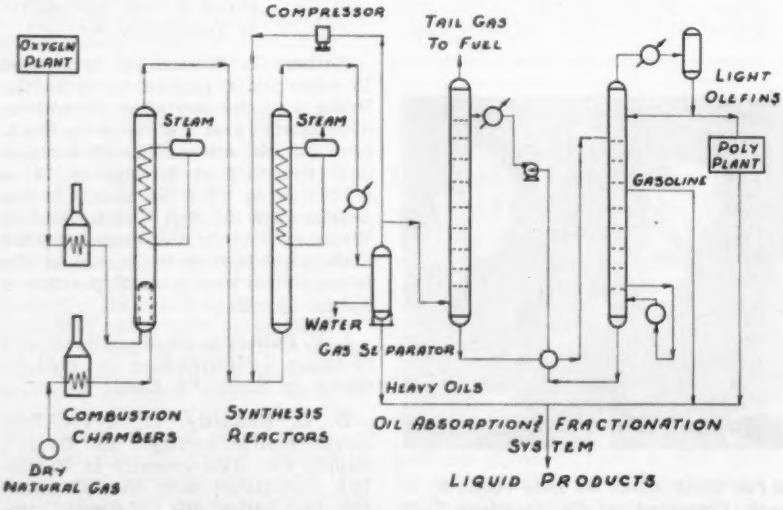
As indicated, the atmospheric reactor consisted of a number of horizontal boiler tubes within a rectangular box. Vertical to the boiler tubes were steel sheets, having a thickness of about 1/16 in. and spaced at intervals of 3/10 in. In order to obtain good heat transfer from the steel sheets to the boiler tubes, the latter were expanded into the holes in the steel sheets, by forcing a ball through the tubes. Each reactor had a total tube surface of 4,300 sq. ft. and a total finned surface of 38,700 sq. ft. for a total cooling surface of 43,000 sq. ft. The capacity for synthetic-oil production for each reactor was only about 18 bbl. per day. The weight of each of these reactors without insulation was about 90,000 lb.

The reactor for use under pressure consisted of a cylindrical vessel in a vertical position, fitted with a double pipe system between tube sheets. The catalyst was placed in the annular space between the inner and outer tubes, and cooling water occupied the space around the outer tubes and inside the inner tubes. The total cooling surface in each of these reactors was about 22,600 sq. ft., and the weight of each, exclusive of insulation, was 108,000 lb. The capacity for oil production of the pressure reactor was equivalent to that of the atmospheric pressure reactor, namely, about 18 bbl. per day. As an indication of the efficiency of this equipment, the over-all volume of the atmospheric chamber was about 650 cu. ft., while the over-all volume of the high-pressure chamber was of the order of 950 cu. ft. With this design, experiments indicated that capacities of these reactors for oil production was limited entirely by the ability to remove heat with good temperature control rather than by the specific catalyst activity. In other words, the same volume of catalyst could produce considerably more oil if the design of the reactor had been improved to permit increased heat removal per unit of catalyst volume.

In practice, four of these chambers were operated as a unit with a common cooling system, with the temperature being controlled by adjustment of the pressure on the water evaporating system. In the average German unit of 1,300 bbl. per day capacity, approximately 72 reaction chambers would be on stream with 18 separate control systems required.

Quite obviously, the investment cost for commercial synthesis plants in Germany was high, being of the order of $7,500 to $8,000 per daily barrel of product.

Synthetic gasoline produced via the Fischer-Tropsch process did not play an important part in the German oil technology during the war. While the synthetic-oil production in Germany was expanded greatly over the war period, the major emphasis was placed on high-pressure hydrogenation in spite of its relative costliness as compared to the Fischer-Tropsch process. The reason for the adoption of this course was the fact that the low quality of the Fischer-Tropsch gasoline by the German technique made it unusable as an aviation-gasoline component. Hence, no new Fischer-Tropsch plants were built in



Process chart for the American development of the Fischer-Tropsch process. 10,000 cu. ft. natural gas (342 lb. carbon) ⟶ 32,000 cu. ft. synthesis gas (304 lb. carbon as carbon monoxide) ⟶ 42 gal. liquid (230 lb. carbon as oil and chemicals.)

Germany during the war, and the gasoline from the existing plants was delegated to motor-fuel usage because of its low octane number. The diesel fraction, however, was of superior quality and was used to upgrade low-quality material from other sources. With the exception of the diesel fraction, the Germans considered the products from the Fischer-Tropsch process as unsuitable for premium fuels and regarded them primarily as raw materials for further chemical and synthetics manufacture.

In so far as the American development of the synthetic-gasoline process is concerned, active interest in this country arose in 1938 although earlier investigations had been carried out on a minor scale. It was recognized at that time that in order for synthetic gasoline to win a place in the competitive American petroleum picture, enormous improvements in efficiency and reduction in investment and operating cost through improved engineering over the German process would be imperative. It was first decided that natural gas under the present price structure was a more economic source of carbon and hydrogen than coal, and research was undertaken to establish a feasible means for the conversion of natural gas into hydrogen and carbon monoxide. In Equation 1 methane reacts with steam and carbon dioxide to form carbon monoxide and hydrogen:

$$6\,CH_4 + 4\,H_2O + 2\,CO_2 \rightarrow 8\,CO + 16\,H_2 \quad (1)$$

This reaction is carried out at atmospheric pressure and about 1,500° F. over catalyst, and since it requires heat, it is carried out commercially in a reformer furnace. In this type equipment, which is currently employed in the manufacture of hydrogen from natural gas, high-alloy tubes are suspended vertically in a fired furnace, and the reacting gases pass downward through beds of catalyst contained in the tubes. The other process is as shown by Equation 2:

$$8\,CH_4 + 4\,O_2 \rightarrow 8\,CO + 16\,H_2 \quad (2)$$

Methane combines with oxygen under pressure and temperature to produce carbon monoxide and hydrogen. This reaction gives off heat which may be used advantageously in other parts of the process. The partial combustion reaction has not been applied commercially at the present time, but for reasons which will be explained later appears to be more desirable for application in the synthetic-gasoline development than the more fully developed reforming process.

The second step in the American synthetic-gasoline development is substantially the same as in the German development; namely, the conversion of mixtures of carbon monoxide and hydrogen to hydrocarbons. Again, tremendous improvements in technology have resulted in greatly increased efficiency and reduced investment cost over the German commercial application. Improvement in the performance of iron catalyst has resulted in the development of a material, considerably cheaper than the German cobalt catalyst, which produces more gasoline of a higher quality over its useful life. In addition, this material simultaneously produces quantities of valuable chemicals.

Investment and manpower requirements for the synthesis reaction have been greatly reduced by the application of the fluidized technique wherein a bed of finely divided solid catalyst is maintained in a turbulent state. The name "fluidized" is employed because the bed of solids behaves like a fluid. This technique has already been applied extensively in the catalyst cracking art. The fluidized technique, wherein the rapidly circulating catalyst particles permit the transfer of enormous quantities of heat to adjoining cooling surfaces with a small temperature variation throughout the bed, is admirably suited to this reaction.

One Process Described

The accompanying flowchart shows diagrammatically one scheme being studied for manufacture of synthetic gasoline. Natural gas under pressure and oxygen are preheated and enter a combustion chamber wherein conversion of the reacting gases to hydrogen and carbon monoxide takes place at approximately 300 psi. pressure and 2,500° F. These gases are cooled with the evolution of useful heat and enter the synthesis reactor which operates at approximately 600° and 250 psi. pressure. The reaction products are cooled and recovery of liquefiable hydrocarbons is carried out at approximately 200 lb. pressure by conventional oil absorption techniques. The recovery step does not differ greatly from the recovery of natural gasoline from gas and the techniques to be employed are similar. Light olefins produced in the process are polymerized to make high-octane gasoline. The efficiency of utilization of carbon from natural gas is considerably greater than that for the utilization of coal in the German technique. Ten thousand feet of natural gas containing approximately 340 lb. of carbon is converted to 1 bbl. of synthetic oil containing approximately 230 lb. of carbon.

The partial combustion process has been shown in preference to the reforming process for synthesis gas manufacture previously described. The former process is more economic since it supplies large quantities of byproduct heat and since it can be carried out at the pressure required for the synthesis and at which natural gas is usually available.

Consideration of the several steps involved in the synthetic-gasoline process shows that there are a number of unique engineering problems. In the preparation of synthesis gas by partial combustion, large volumes of oxygen will be required, and this material is to be prepared by a modification of the Linde-Frankl technique of low-temperature distillation. While this process has been employed for some time on a small scale for the manufacture of oxygen, consideration is being given in the contemplated installation, which is many times larger than any existing oxygen unit, to the possible improvement of the economics of the operation through the use of centrifugal air compressors, centrifugal expanders, reversing heat exchangers, and other modifications.

The air compressors consist of two parallel units. Each unit is made up of two compressors with their individual drivers operating in series. Considerations of operating flexibility indicated that separate drivers are more desirable. Each unit consists of one compressor handling 93,000 standard cubic feet per minute (s.c.f.m.) from 13.2 to 40.5 psia. and requiring 12,750 hp. and the second-stage compressor handling 93,000 s.c.f.m. from 39 to 102 psia. and requiring 8,300 hp. The operating speeds for the respective units are 2,800 and 3,000 r.p.m. The steam conditions for all turbines for the air compressors are 600 psig., 750° F. at the throttle and exhausting to 3 in. Hg absolute. We believe that this installation totaling 42,000 hp. will be the largest domestic installation of centrifugal compressors for compressing air to the final pressure mentioned above.

The oxygen compressors are unusual in that this is probably the first application in this country of centrifugal compressors for compressing oxygen from 15.5 to 310 psia. The quantity of oxygen handled by each of the two units is 17,700 s.c.f.m. Each of these units consists of three compressors operating in series. The first two machines are driven by a common turbine of 4,760 hp. and the last stage of compression is handled by a separate compressor and driver of 1,720 hp. Steam conditions for these turbines are 600 psig., 750° F. at the throttle and exhausting at 185 psig. and about 500° F.

The air expanders, used to provide refrigeration, will operate at a speed of approximately 9,000 r.p.m., inlet pressure about 91 psia., outlet pressure 21 psia., with inlet and outlet temperatures of —233° F. and —305° F. respectively. Units of the size required for the job have never been employed previously.

The use of aluminum as one of the materials of construction for the process equipment in the oxygen plant presents some unusual fabricating

(Continued on page 139)

DEEP-WELL CAMERA

Permits visual examination of bore holes as aid in studies of subsurface formation characteristics

by O. E. Barstow and C. M. Bryant†*

VISUAL examination of bore holes as an aid in studies of subsurface formational characteristics, and inspection of casing string interiors and tools lost in the hole, is being made possible by an improved deep-well camera recently developed and tried out in the field.

*Physical research laboratory, Dow Chemical Co., Midland, Mich. †Dowell Incorporated. Article abridged from a paper presented at the A.S.M.E. spring meeting, Tulsa.

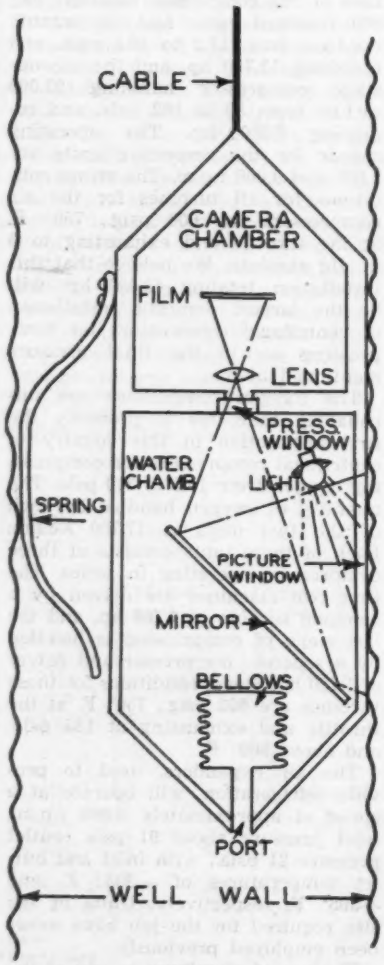


Fig. 1—Schematic outline of the optical system and general principle of the camera. For clarity, the dimensional proportions have been somewhat distorted

The camera is run into the well on an electric cable which serves to transmit the power required by the apparatus and to provide remote control of the camera from the surface. As shown in Fig. 1, the apparatus consists of two main parts: a camera chamber and a water chamber. The camera chamber contains air at atmospheric pressure and houses the camera, including lens, film, and film-drive mechanism.

The water chamber, which is filled with clear water, is used merely to provide a path of clear liquid between the lens and the rock formation being photographed, an idea originally proposed by Reinhold.[1] The water chamber houses a light to illuminate the subject and an inclined mirror which permits the camera to view the wall of the well horizontally through the cylindrical picture windows in the side of the water chamber. The bellows shown in Fig. 1 serves to equalize the internal and external pressures on the water chamber so the picture window can be relatively large without encountering difficulties due to high pressure. In the bulkhead at the top of the water chamber is a pressure window immediately below the camera lens. This window must withstand full well pressure, but this is a relatively simple matter because the window diameter can be small.

Action of Spring

Attached to the outside of the case is a spring which pushes the picture window against the well wall thus minimizing the thickness of turbid well fluid through which the picture must be taken. This spring also assists in keeping the camera stationary during exposures. By pushing the picture windows against the formation, satisfactory pictures have actually been made in water so turbid that a sample of it in a pint milk bottle completely obscured any vision through the bottle. It is, however, always an advantage to have the well fluid as clear as possible. This is particularly true where there may be difficulty having the camera fit up tight against the formation or where the well wall may be rough and irregular.

The diameter of the water chamber is limited by the diameter of the smallest well in which the apparatus is to be used. Making the water chamber large is an advantage because this provides a large picture window and increases the area of the well wall which is photographed. Also the greater the diameter of the cylindrical picture window the better it will fit up against the rock, thereby improving the pictures in case the well fluid is turbid. Making the water chamber fairly long is also an advan-

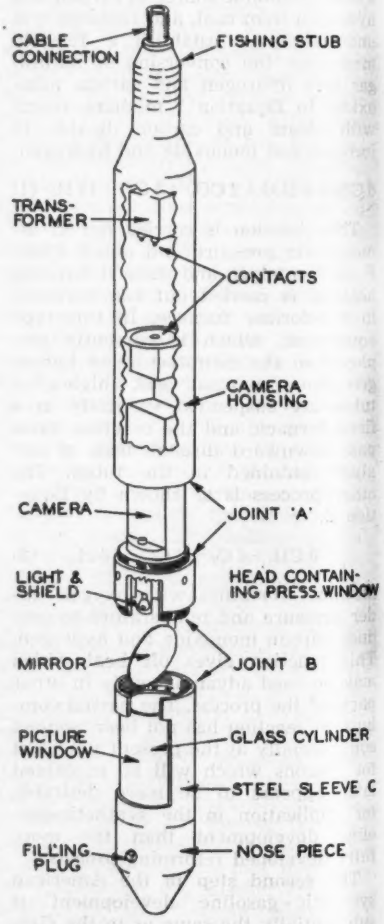


Fig. 2—Cutaway drawing, more nearly to scale, giving a better idea of how some of the parts are constructed and arranged

tage, since this increases the distance from lens to subject, thereby increasing the depth of field. This facilitates sharp focusing even when the well wall is irregular with various parts of the formation at different distances from the picture window.

The camera requirements are not severe. The camera's field angle should be wide enough so that the extent of the subject covered is limited only by the mirror or picture window. Due to refraction at the pressure window the subject appears to the camera to be only three-fourths as far from the camera as it actually is. The lens is focused accordingly and permanently locked. To increase the depth of field, the lens may be stopped down to f/16 or smaller. No shutter is needed since exposures can be made by turning the light on the desired exposure time, then turning it off while forwarding the film and shifting the camera to the next location. The camera must have enough film capacity so that frequent reloading is not necessary and the film drive mechanism must be controlled electrically.

Description of Equipment

Fig. 2 is a diagram of the actual construction of one of these cameras. A Pyrex glass cylinder forms part of the water chamber. It is surrounded by a steel sleeve having a rectangular opening about 3 in. wide by 4½ in.

(Continued on page 92)

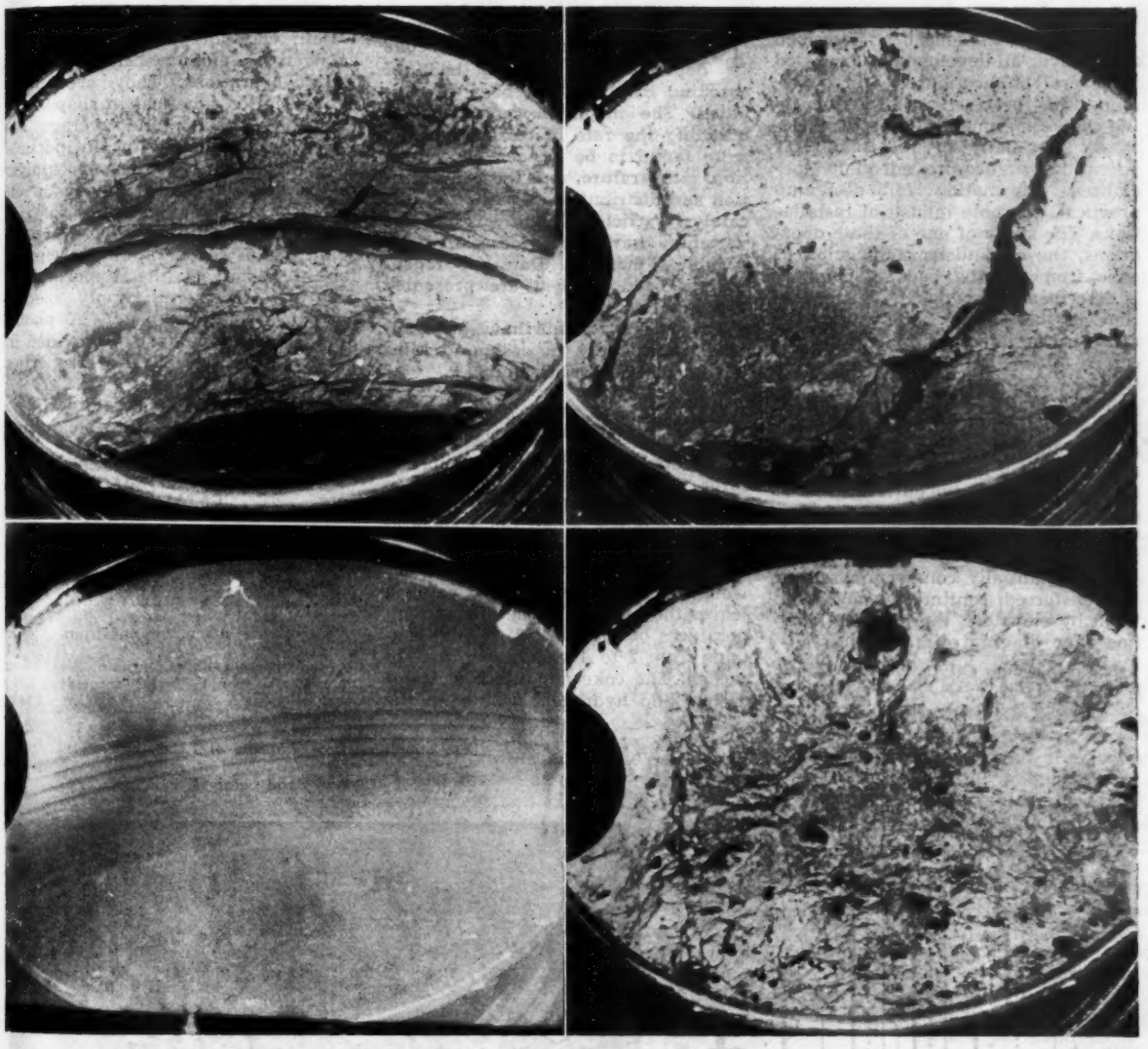


Fig. 3—Examples of some photographs taken in a well in West Texas. The formation is the San Andres section of the Permian lime in the Hendricks pool. Over 400 pictures were taken of this well at depths of from 2,300 to 2,725 ft. When the pictures were taken, the well fluid was within 200 ft. of the top of the well

Upper left: Indications of some porosity appear in the upper part of the picture together with some rather pronounced fractures cutting through the porous zone. Immediately below this is what appears to be a small sand stringer underlain by some mottled limestone containing small fractures. The mottled effect probably is due to the presence of small deposits of anhydrite. Depth is 2,523 ft. Upper right: This picture, taken at 2,528 ft., shows a well-developed porous zone on the right side with a cavity, probably due to the enlargement of a fracture by leaching. The entire section shows a considerable amount of porosity, evidenced by the small openings. One small stylolite traverses the picture beginning in the upper part on the right. It joins another fracture on the left. Lower left: Photograph of a section of casing at 2,361 ft. showing a collar. Threads are visible. Lower right: Section at 2,719 ft. showing some very large openings together with well-developed smaller openings, most of which are confined to the lower one-third of the picture. Some of this porosity may have been formed by leaching of the remains of living organisms such as corals. Some of the apparent distortion around the large openings may have been caused by the growth of the reef structure

Combustion of Coke Deposit on Synthetic Bead Cracking Catalyst

by W. A. Hagerbaumer and Russell Lee**

ABSTRACT

THE stagewise combustion of coke deposits from flowing beds of cracking catalysts has been investigated. The major process variables affecting the rate of carbon burning were found to be oxygen concentration, temperature, and the concentration and distribution of carbon on the catalyst particles. The effects of these variables have been correlated by graphical methods. Data for regenerating bead catalyst are presented and discussed.

The correlated data have been applied successfully in designing kilns for commercial T.C.C. units.

THE Thermofor catalytic-cracking (T.C.C.) process has been described and its over-all development discussed in several publications.[1,2,3,4] In developing this process, as is frequently the case, experimental work was necessary on many of its component operations to acquire adequate specialized information for designing practical, operable industrial installations. The study of one of these operations, the continuous combustion of coke from flowing beds of catalyst, is described in this paper. This operation is particularly interesting because it is relatively new and has received little attention in the literature.

A T.C.C. unit consists essentially of a reactor, in which the petroleum charge stock is contacted with the catalyst, and a kiln in which the catalyst is revivified by burning off the coke deposited on the catalyst during the cracking reaction. The catalyst flows through both of these vessels as a substantially compact mass and is transferred continuously between them by elevators. Fig. 1 is a simplified flow diagram of the process.

*Socony-Vacuum Oil Co., Inc. A paper presented at the A.S.M.E. spring meeting, Tulsa.

The process requirements of the reactor establish the design basis of the kiln. Thus, for optimum cracking results, volumetric ratios of catalyst to charge oil from 1.5 to 3.5 are required; catalyst enters the reactor at temperatures ranging from 850° to 1,050° F. and bearing less than 0.5 weight per cent of carbon; catalyst leaves the reactor for the kiln at temperatures of 800° to 950° F. and contains from 2 to 4 weight per cent of carbon. The coke deposits consists of carbon and hydrogen, usually in the proportions of 20 to 1 by weight.

Both clay and synthetic types of catalysts are employed in commercial T.C.C. operations. They are either cylindrical or spherical in shape, mechanically rugged, and average between 0.10 and 0.16-in. in particle size. Engineering studies of catalyst regeneration have been made on all catalysts used or contemplated for use in T.C.C. units. While the basic principles of regeneration are similar for all catalysts the experimental data reported herein apply specifically to "bead catalyst."[5] A photograph of bead catalyst is provided in Fig. 2 and typical physical properties are shown in Table 1.

All known cracking catalysts lose activity when exposed to steam and

TABLE 1—PHYSICAL PROPERTIES OF TYPICAL COMMERCIAL BEAD CATALYST

Density, g. per cu. cm.:	
Apparent	0.70
Particle	1.10
Substance	2.42
Surface area, sq. m. per g.	420
Pore volume, cu. cm. per g.	0.50
Average pore diameter (angstrom unit)	47
Average particle diameter, mm.	3
Particle-size range, Tyler screen scale	4 to 12

Fig. 1—(Left) Simplified flow diagram of T.C.C. process

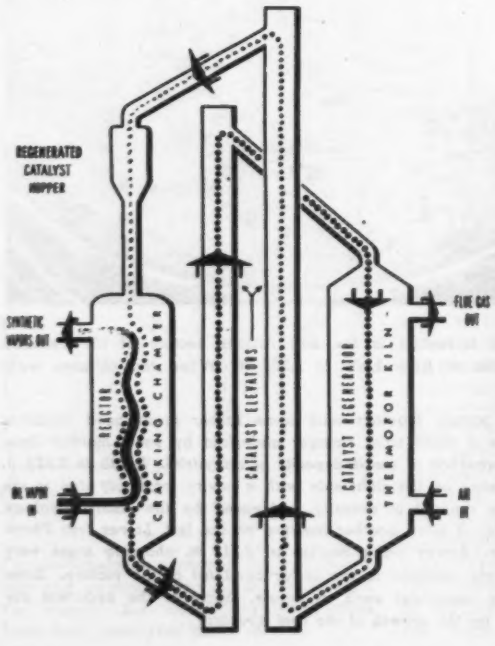
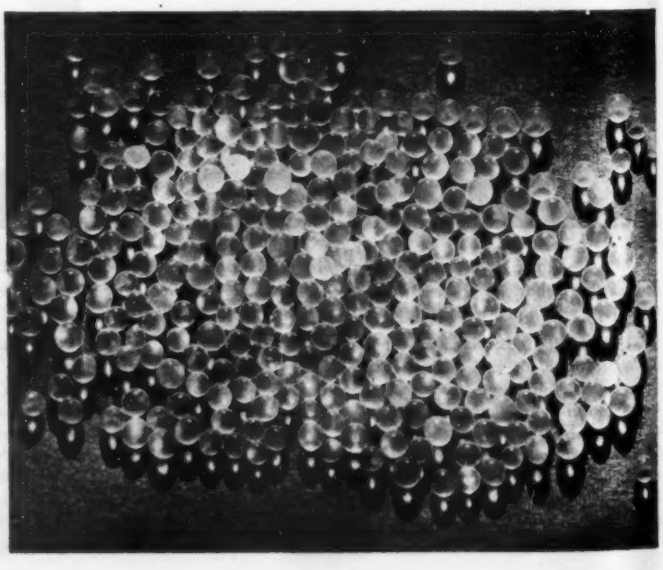


Fig. 2—(Below) Bead catalyst



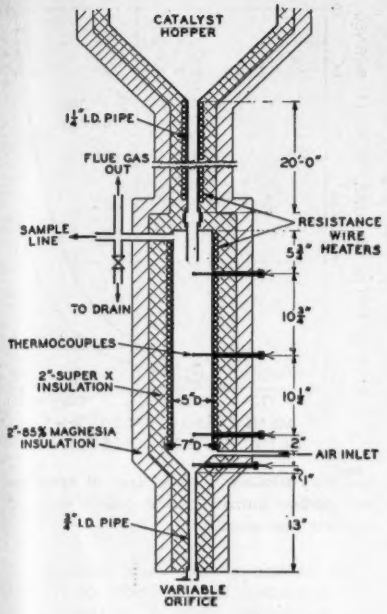


Fig. 3—Single-zone laboratory kiln

elevated temperatures. The rate of activity decline of a given catalyst is a function of its inherent stability and the relative magnitude of the above deactivating factors. It is evident, therefore, that the temperature of the catalyst must be regulated during regeneration to minimize catalyst deactivation.

Multizone Kiln Development

Although there are several feasible methods for regenerating catalysts in moving bed systems, process engineering and economic considerations led to the development of a "multizone" type of kiln for use in the T.C.C. process. In the multizone kiln, coke is burned from the catalyst in a series of zones with temperature control being effected by cooling coils located at various levels in the kiln.

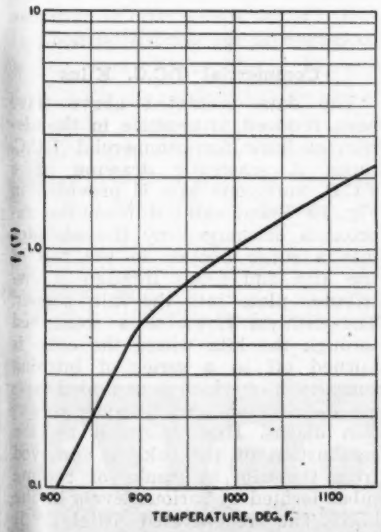


Fig. 4—Effect of temperature on carbon-burning rate

Experimental Procedure

Critical analysis of the problem of burning coke from a flowing bed of catalyst revealed the following main factors for evaluation:

1. Coke deposit: (a) Initial carbon concentration on the catalyst. (b) Fraction of the initial carbon remaining on the catalyst. (c) Relative proportions of carbon and hydrogen.

2. Operating conditions: (a) Temperature. (b) Air rate. (c) Oxygen concentration. (d) Catalyst volume in burning zone.

The type of equipment used to study multistage burning of coke deposits is shown in Fig. 3. Coke-bearing catalyst, obtained from a T.C.C. reactor, was passed repeatedly through an adiabatic combustion chamber until substantially all the carbon was burned off. Three combustion chambers, having effective catalyst volumes of 0.13, 0.26, and 0.52 cu. ft., were used. These chambers provided 2.5, 5, and 10 minutes catalyst-residence times, respectively, at the catalyst flow rate employed. All were equipped for countercurrent flow of catalyst and air.

In conducting the experimental work the initial carbon concentration was controlled at 1, 3, and 6 weight per cent and the atomic ratio of hydrogen to carbon in the coke deposit was varied from 0.3 to 1.0 by altering the operating conditions of the cracking reactor. Study of the effects of kiln-operating variables was made using temperatures ranging from 570° to 1,150° F. and air rates ranging from 1 to 16 cu. ft. per minute per cu. ft. of catalyst volume. All regenerations were conducted at atmospheric pressure, which is substantially the condition in commercial T.C.C. kilns.

Correlation of Data

The laboratory data on the rate of combustion of carbon from flowing beds of bead catalyst at atmospheric pressure were correlated by the relation:

$$W = O_m \cdot f_1(T) \cdot f_2(C_o) \cdot f_3(C/C_o) \quad (1)$$

where

W = carbon-burning rate, lb. carbon per hour per cu. ft. of catalyst bed.

O_m = Log mean of the oxygen concentration of the air entering and the flue gas leaving a burning zone, mol fraction.

$f_1(T)$ = empirical function of average catalyst temperature, T, °F.

$f_2(C_o)$ = empirical function of initial carbon concentration, C_o, weight per cent.

$f_3(C/C_o)$ = empirical function of the fractional carbon concentration.

C = average weight per cent carbon on catalyst in a burning zone.

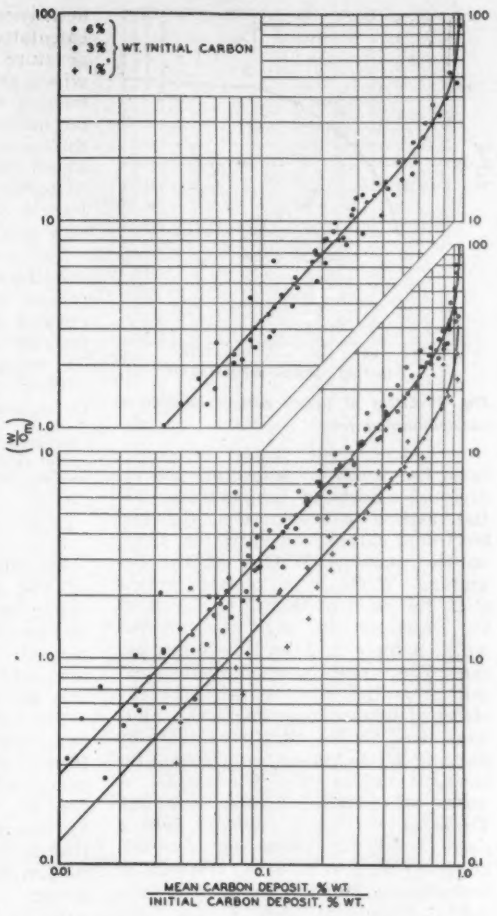


Fig. 5—Carbon-burning rate corrected to 1,000° F.

Preliminary examination of the data revealed that for approximately constant conditions of temperature, initial carbon concentration, and fractional carbon concentration, the carbon-burning rate, W, varied directly with the log mean oxygen concentration, O_m. This direct relationship between W and O_m thus permitted the use of the quantity W/O_m in evaluating the effects of the other terms in Equation 1.

A series of successive approxima-

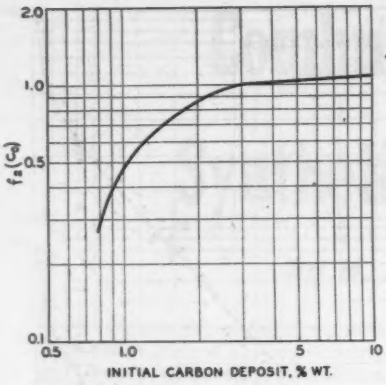


Fig. 6—Effect of initial carbon deposit on carbon-burning rate

tions was made to determine the individual effects of temperature, initial carbon concentration, C_o, and fractional carbon concentration, C/C_o, on the quantity W/O_m. At the beginning W/O_m was plotted versus C/C_o for each of the three levels of C_o employed in the experimental work, namely 1, 3, and 6 weight per cent. These plots were studied to obtain a preliminary appraisal of the effect of temperature on W/O_m. Thus from these data a chart was made by plotting W/O_m versus temperature for constant values of C/C_o and C_o. A series of parallel curves resulted. These curves were resolved into a single curve expressing tentative relative burning rate as a function of temperature and having arbitrarily a value of unity at 1,000° F. The final plot of this function $f_1(T)$, is presented in Fig. 4. A second plot was then made of W/O_m versus C/C_o in which the observed values of W/O_m were corrected to the base temperature of 1,000° F., as illustrated in Fig. 5. This revealed that the curves for each level of initial carbon concentration, 1, 3, and 6 weight per cent, were parallel and hence the effect of C_o on W/O_m was constant for all values of C/C_o. The effect of C_o on W/O_m relative to a fixed C_o, taken arbitrarily as 3 weight per cent, was next evaluated by adjusting the experimental values of W/O_m for each coke deposit investigated to 1,000° F. and constant C/C_o using tentative forms of Figs. 4 and 5, respectively. Charts resembling Fig. 6 were obtained. Fig. 6 was then used to adjust all experimental values of W/O_m to fixed values of C_o (3.0 weight per cent) and temperature (1,000° F.) to obtain a curve similar to Fig. 7 evaluating $f_3(C/C_o)$.

The evaluations of the three functions were made more precise by successive approximations in which deviations associated with any particular variable were eliminated. Figs. 4, 6, and 7 are the final charts evaluating the functions in Equation 1, $f_1(T)$, $f_2(C_o)$ and $f_3(C/C_o)$, respectively. It is interesting to note that the apparent activation energy for carbon deposits, calculated from Fig. 4 for the temperature range from 800° to 900° F. where the change in the rate of combustion with temperature appears to be influenced only slightly by gas-diffusion rates, is of the order of 35,000 calories per g. mol as compared to 44,000 calories per g. mol found by Parker and Hottel[6] for the combustion of brush carbon.

The accuracy of the correlation was tested by comparing the experimental carbon burning rates with those calculated from the correlation charts for the same operating conditions. The mean deviations between the calculated and experimental carbon burning rates were as follows:

Wt. per cent initial carbon concentration	Mean deviation, per cent
1	±24
3	±18
6	±18

The discrepancies between calculated and experimental data indicated above can be accounted for largely by the probable errors of the experimental measurements of catalyst temperature, carbon concentration, and gas composition.

The relative amounts of water, carbon monoxide, and carbon dioxide formed during combustion of coke deposits affect air requirements and heat-liberation quantities and must be taken into account in design studies of kilns. The amount of hydrogen in the catalyst deposit entering a kiln is determined principally by the reactor temperature. The amount of hydrogen in coke deposits on bead catalyst covered in these studies ranged from 2.5 to 8 weight per cent. The average was 4.8 weight per cent or an atomic ratio of hydrogen to carbon of 0.6. The atomic ratio of hydrogen to carbon burned at a given point in a regeneration is determined by the ratio of hydrogen to carbon in the initial coke deposit and the fraction of the initial carbon remaining on the catalyst at the point being considered. The variation in the ratio of hydrogen to carbon burned as the regeneration progresses is illustrated in Fig. 8. The relative amounts of carbon dioxide and carbon monoxide leaving the burning zones of a kiln operating with bead catalyst are shown in Fig. 9.

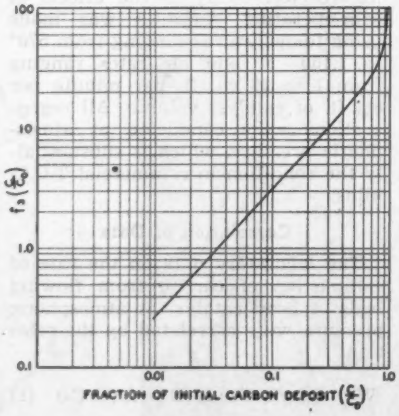


Fig. 7—Effect of fractional carbon concentration on carbon-burning rate

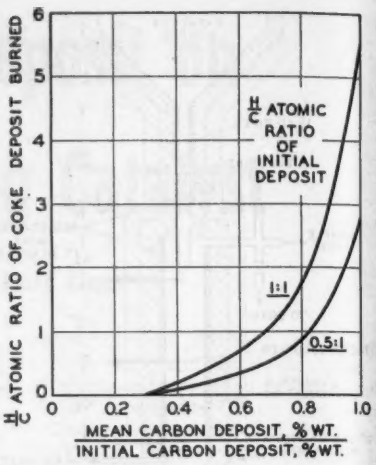


Fig. 8—Variation in proportions of hydrogen and carbon burned during course of bead-catalyst regeneration

The net heat of combustion of coke deposits was determined from heat balances on the experimental data to be:

$$\text{Net heat of combustion B.t.u. per lb. of carbon} = 4{,}100 + 10{,}100\left(\frac{CO_2}{CO_2 + CO}\right) + 3{,}370\,(H/C) \quad (2)$$

where $\frac{CO_2}{CO_2 + CO}$ represents the relative volumes of these gases in the flue gas.

H/C is the atomic ratio of hydrogen to carbon in the deposit burned.

Commercial T.C.C. Kilns

The data presented above have been reduced to practice in the design of kilns for commercial T.C.C. units. A schematic drawing of a T.C.C. multizone kiln is provided in Fig. 10. Spent catalyst from the reactor is discharged by the elevator into a surge hopper in the top of the kiln and flows through a distributor plate into the kiln proper. The catalyst flows as a solid bed through the kiln where the coke is burned off in a series of burning zones each of which is equipped with air distribution and flue-gas collection means. Heat liberated by the combustion of the coke is removed from the kiln by banks of cooling tubes located at various levels in the kiln. The regenerated catalyst is withdrawn from the kiln through a baffle-type system into a discharge

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THE VEHICLE: Order from a paint manufacturer of integrity, telling him the service conditions to be met. Then you can be sure that the vehicle in your aluminum paint will contain the ingredients necessary for the job: heat resistance, maximum flexibility, extreme durability, or high reflectivity.

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line leading to an elevator which returns it to the reactor. The rate of flow of catalyst through the kiln is controlled by a valve in the discharge line. The temperature of the catalyst leaving the kiln is regulated to that desired in the reactor by cooling coils located below the bottom burning zone.

Cooling is accomplished by direct generation of steam at 450 psig. from water circulated through tubes at a rate five times the design steam-generating capacity of the kiln. The steam flows to the refinery distribution system from a flash drum where a water level is maintained by a feed-water pump.

The combustion of the hydrogen in the coke deposit must be considered in regulating temperatures in the kiln. The ratio of hydrogen to carbon burned is greatest in the first zone of a kiln and decreases rapidly to zero as the regeneration progresses. In commercial practice, deactivation of the catalyst is minimized by holding the temperature of the catalyst below 1,000° F. in the first zones of a kiln where a relatively high steam partial pressure exists and then allowing it to increase gradually to 1,150° F. in the lower zones where no hydrogen is being burned.

Air, preheated to 600° to 1,000° F. by a line burner, is supplied to the kiln at about 2 psig. by blowers. It is fed to each zone through inlet ducts which are connected in parallel to large ducts extending along the outside of the kiln. The rate of air feed is controlled by dampers in the inlet ducts. The air is distributed over the horizontal area of the kiln by a grid of inverted V-shaped channels. From the inlet grid the air flows through the moving bed of catalyst to similar flue-gas collector grids located at the top and bottom of the zone. The internal construction of a zone of the kiln is illustrated in Fig. 11. The flue gas flows from the collector grids to large ducts outside the kiln where it is conducted to cyclone separators for removal of catalyst fines before discharging to the atmosphere.

The 30 T.C.C. kilns now operating in the United States are approximately square vessels designed for 3-psig. operating pressure. The shells are of carbon steel protected by a

(Continued on page 97)

TABLE 2—TYPICAL OPERATING DATA FOR T.C.C. KILN REGENERATING BEAD CATALYST

Zone No.	Air rate, c.f.m.	Oxygen content of flue gas, per cent vol.	Carbon burned, lb./hr.	Catalyst temp., °F. In	Catalyst temp., °F. Out
1	2,580	2.7	420	820	955
2	2,140	2.9	552	955	1,060
3	1,830	4.6	463	950	1,050
4	1,730	5.3	408	980	1,080
5	2,470	8.4	412	975	1,060
6	2,190	10.4	333	1,060	1,135
7	2,200	12.3	199	1,065	1,035
8	2,160	13.6	123	1,055	1,110
9	2,180	14.0	111	1,110	1,130
10	1,140	11.3	129	1,130	1,150
Total	20,620		3,150		

Catalyst rate, tons per hr.	100
Carbon on catalyst, per cent wt.	
To kiln	2.0
From kiln	0.4
Temperature of air to kiln, °F.	890
Steam produced, lb. per hr.	21,400

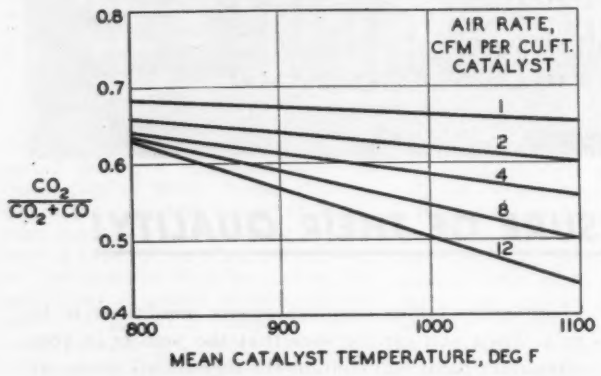


Fig. 9—(Left) Proportions of CO_2 and CO in flue gas from regeneration of bead catalyst

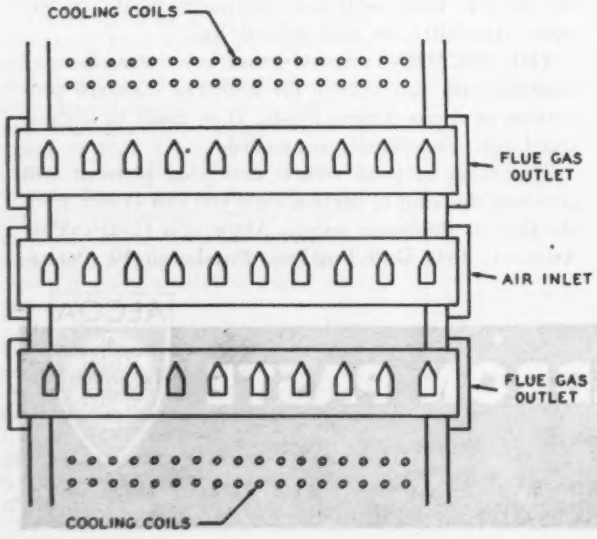


Fig. 10—(Below) T.C.C. multizone kiln

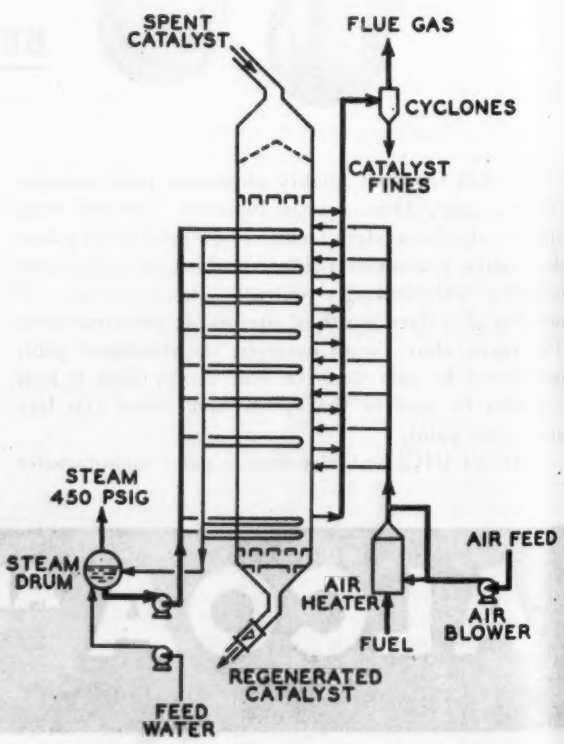
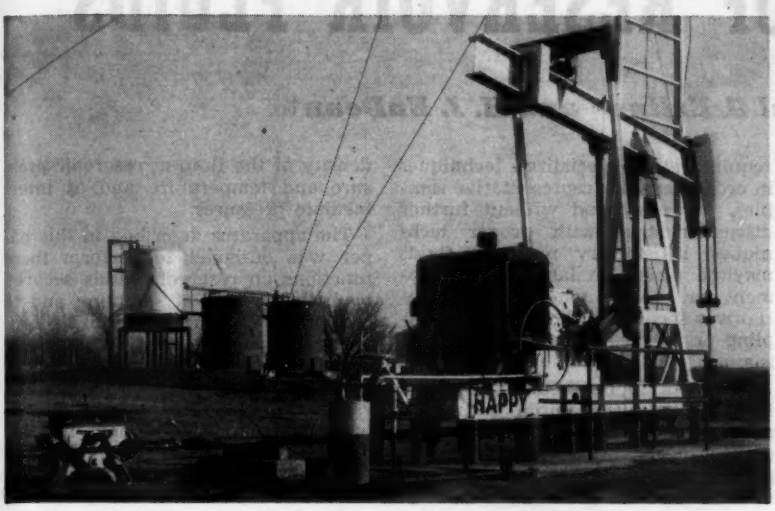


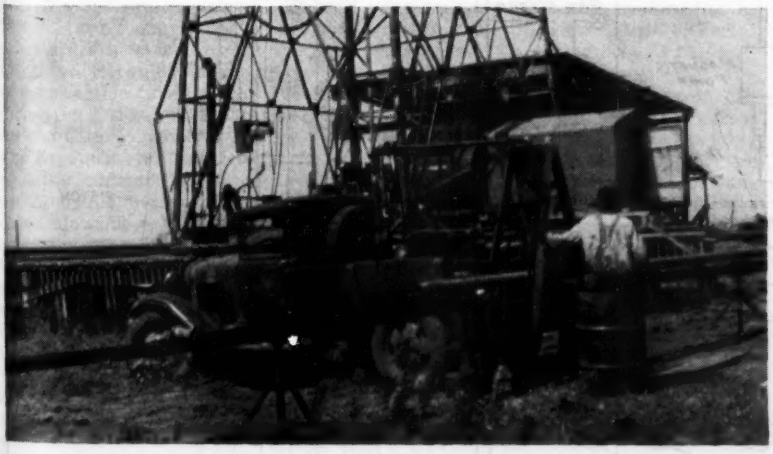
Fig. 11—(Lower, left) Typical zone of T.C.C. kiln

OPERATING IDEAS



Pumping Unit Powers Pipe-Line "Jerk" Pump

A GEARED pumping unit operated by Mid-Continent Petroleum Corp. in the Yale field is being utilized to pump two wells and also a small "jerk" pump which moves lease production from the battery to the pipe line. As shown, the second well pump and the jerk pump (left) are operated by power takeoffs from opposite sides of a bell-crank installation (below and behind the samson post) working off the walking beam. The 36-in. wheel on the engine is a safety starting device made by the field superintendnt to supplant the conventional engine-starting crank.



Mobile Hydraulic Press for Straightening Pipe

A MOBILE hydraulic press is providing pipe-straightening service for a number of operators and contractors in various fields out of Oklahoma City. The press, built in a machine shop out of miscellaneous scrap material, is mounted with its power unit on a 1928-model Ford truck. Power is supplied by a small rotary pump driven by a one-cylinder liquid-cooled gasoline engine. The outfit is capable of straightening 7,000 ft. of drill pipe in from 8 to 10 hours at the well location.

Portable Well-Testing Unit

A SMALL, light-weight testing unit, easily carried by two men, is used by Superior Oil Co. in the New Harmony (Illinois and Indiana) field for periodical checking of the production being run to central lease tanks. The units sets in a bypass connection provided in the lead line from the well to the central tanks. As shown in the accompanying picture, it includes a small separator (left) and a positive displacement-type meter, which with the necessary connecting lines are permanently mounted on a light skid base. Gas vented from the separator is returned to oil stream after metering the fluid. Operation is typical of large-scale individual testing units in common use, although in many of the latter calibrated volume tanks instead of meters are employed for gaging the oil. Only two connections are necessary, one at the separator inlet from the well lead line and the other at the outlet of the metered oil and gas to the lead-line return.

Truck-Driven Wire-Line Reel

BY mounting the well-servicing line reel on the side of the truck with a belt drive from a sheave wheel extension from the truck's rear wheel (see accompanying picture) the operator has eliminated the need for a separate small engine for power to spool the line. The line is used for measuring depths or for running paraffin knives or other servicing tools.

Apparatus for the

ANALYSIS OF RESERVOIR FLUIDS

by Paul G. Exline* and H. J. EnDean†

SINCE the pioneering work of Lindsly[1] in securing and examining subsurface samples of reservoir fluids, the recognition of the usefulness of this work has become widespread and a substantial body of literature has been built up describing various techniques and applications. In this work, a reservoir fluid is understood to refer to the hydrocarbon liquids and gases as they exist in the producing formation. Samples of reservoir fluids may be secured by sampling with a specially designed bottom-hole sampler[1,2,3,4] at the bottom of the well or by taking samples of the liquid and gaseous phases in the proper portions at the separator.[5] Methods of securing suitable samples of either kind are described in the literature and require rather specialized techniques in order to secure representative samples. It is assumed without further discussion that with proper techniques, satisfactory reservoir fluids may be placed in laboratory equipment for analysis whether the material was secured by bottom-hole sampling or by recombination of surface samples.

The data to be secured from the fluid include the initial saturation pressure or bubble point, the gas solubility in the oil at reservoir temperature and pressure and at intermediate pressures down to atmospheric, the per cent shrinkage of the liquid phase at reservoir temperature and pressure at various pressures down to atmospheric, the viscosity of the reservoir fluid as a function of pressure from reservoir pressure down to atmospheric pressure, the deviation factor of the liberated gases, the density of the fluid at reservoir pressure and temperature and at intermediate pressures.

The apparatus described in this paper was designed to perform these functions on reservoir fluids secured by both methods of sampling and to recombine the surface samples. Insofar as was possible, the apparatus was designed to be highly flexible in operation to permit use of various analysis techniques. Four essential features common to equipment for this purpose are: a pressure-tight system suitable for working pressures up to the maximum reservoir pressures, means for varying the volume of the system, means for stirring the contents of the system, and ability to operate at temperatures as high as 350° F. Various shapes and sizes of pressure systems have been used by other investigators, some of them being the sampler itself which was used

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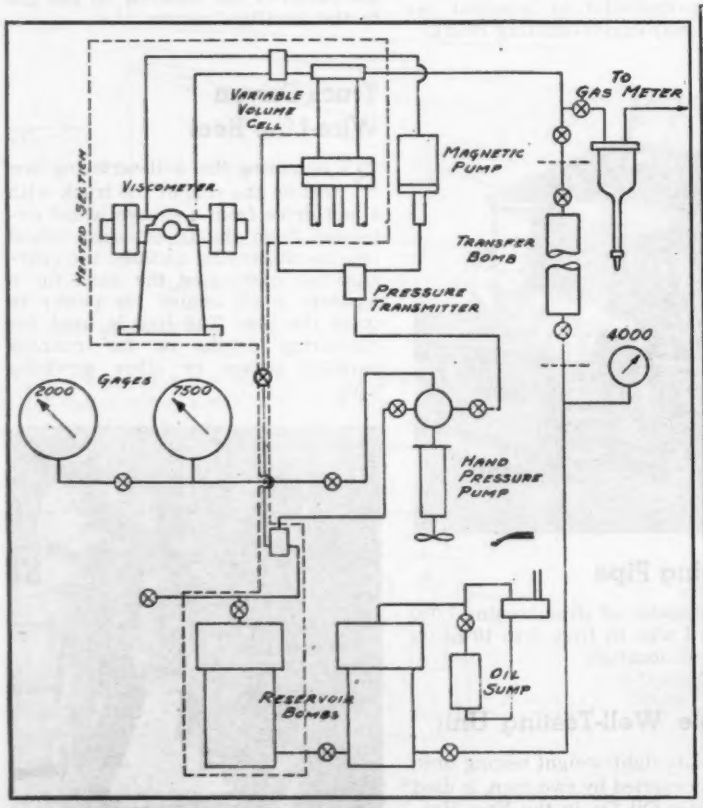

Fig. 1—Schematic diagram of complete pressure system

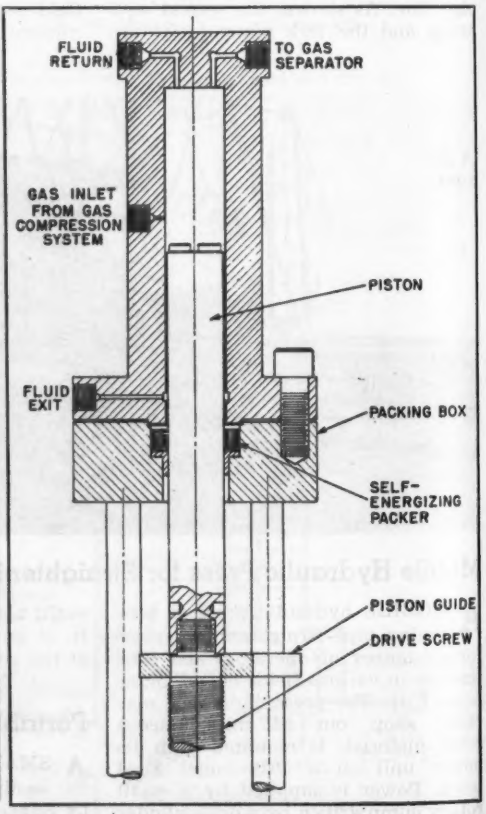

Fig. 2—Variable-volume cell

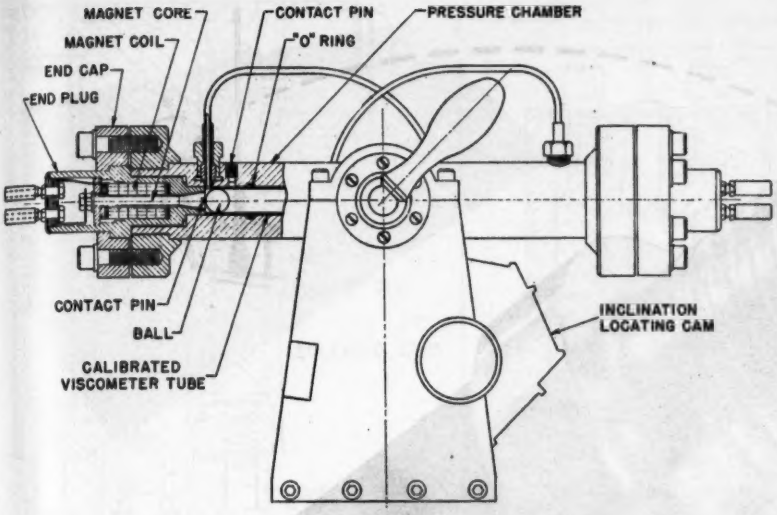

Fig. 3—Rolling-ball viscometer

to collect the sample.[1,2,3,6,7,8,9] In the apparatus described, a rolling-ball viscometer is included as part of the pressure system.

The usual method of altering the volume of the system has been to introduce or withdraw mercury from the system. Since mercury does not enter into combination with the reservoir fluid, nor is it soluble with them, it can be considered as an inert material conveniently capable of altering the system volume. It has several drawbacks which are desirable to avoid if possible. First, mercury is perhaps the most difficult fluid to hold in a pressure system since it can leak through crevices which are impervious to other liquids and gases. Secondly, although no apparent reaction takes place with some reservoir fluids, notably the sour crudes of the Permian basin, the mercury becomes emulsified with the oil requiring considerable labor to clean the apparatus and to recover the mercury following a run. In the present apparatus, the use of mercury for changing the volume of the system has been avoided by use of a variable volume cell in which a metal piston, operating through a packer, is used for altering the volume.

The fluids in the pressure system have usually been stirred by shaking or rotating the pressure chamber in order to get the necessary stirring of the fluid. Especially when mercury is present, the fluid in a long cylindrical chamber will be violently stirred as the mercury is allowed to flow from one end to the other. In the apparatus described, a reciprocating pump withdraws fluid from the bottom of the variable volume cell, pumps it through the system to return at the top of the cell where it is violently jetted downward toward the gas liquid interface. This pump is operated by a magnetic solenoid and thus needs no mechanical parts operating through a pressure seal.

The Complete Pressure System

A schematic diagram of the complete pressure system is shown in Fig. 1. This system can be described as being made up of three independent parts: (1) the analysis section in which both the bottom-hole samples and recombined samples are analyzed; (2) the gas compression system used for the quantitative injection of gas into the analysis system for recombination with the separator liquid in the correct proportion, and (3) the pressure-indicating system for indicating the pressure within either of the other two systems during a test. The analysis section consists of the variable volume cell, the viscometer, the magnetic pump, and the necessary connecting tubing. The variable volume cell and the viscometer are enclosed in an insulated cabinet containing equipment for heating and circulating the air to maintain constant temperature. During a test run, the analysis system is isolated from the other two sections.

The gas-compression system is composed of two pressure chambers and a high-pressure pump used for displacing mercury from one bomb into the other to compress the gas to be injected into the analysis section. The two reservoir bombs are identical with those used for the recombination experiments of Botset and Muskat.[5]

The pressure-indicating system consists of two bourdon-type pressure gages, one of 2,000-psi. range, and the other, of 7,500-psi. range. These two gages are connected to the system in parallel so that the lower range gage may be isolated when operating at pressures above 2,000 psi. A hand pressure pump, consisting simply of a small screw-operated piston working through a packer, is used for taking up volume changes in the indicating system resulting from changes in pressure. Two pressure transmitters are used for isolating the indicating system from the analysis and gas compression systems respectively. The transmitters consist simply of a small mercury "U" tube with an electrical contact in one leg. During a test, the mercury level is maintained at the contact point by manipulating the hand pressure pump. The pressure-indicating system is completely filled with a light hydraulic oil, and the displacement of the hand pressure pump needs be only that required to compensate for the compression of the oil and the expansion of the bourdon tubes and other parts of the indicating system. The contact of the pressure transmitter is connected with an electronic relay which causes a pilot light to glow when contact is made.

The Analysis System

As stated above, the principal components of the analysis system are the variable volume cell, viscometer, and the magnetic pump which are shown in Figs. 2, 3, and 4 respectively.

The Variable Volume Cell

The variable volume cell consists of a heavy-walled tubular piece closed at one end and bolted to a section containing the packer through which the piston enters the cell. The cell assembly is supported from a heavy base (not shown in the figure) which carries the mechanism for moving the piston. The clearance between the piston and the wall of the cell is large enough to permit fluid to flow past it freely to the lower outlet of the cell. One opening at the top is used for completing the circuit through the other parts of the system while the other opening is used for withdrawing fluid from the system. A fourth opening at the center of the cell is used for injecting gas in the recombination experiments. Rotation of the piston is prevented by a guide working on diagonally opposite supporting posts. A heavy screw attached to the piston is given longitudinal motion by means of a rotating nut located between the thrust bearings. Rotation of the nut is accomplished by means of a hand crank through a worm and gear combination.

A piston motion of 1 in. causes a change in volume of 20 cc., and the gearing is such that this travel is produced by 200 revolutions of the hand crank. Volume changes are indicated by means of a counter located directly above the hand crank, both of which may be seen on the right side of the panel in Fig. 7. The counter is coupled to the crankshaft by means of a Selsyn transmitter and a receiver. A magnetic locking device prevents the crank from turning when the Selsyn units are not energized.

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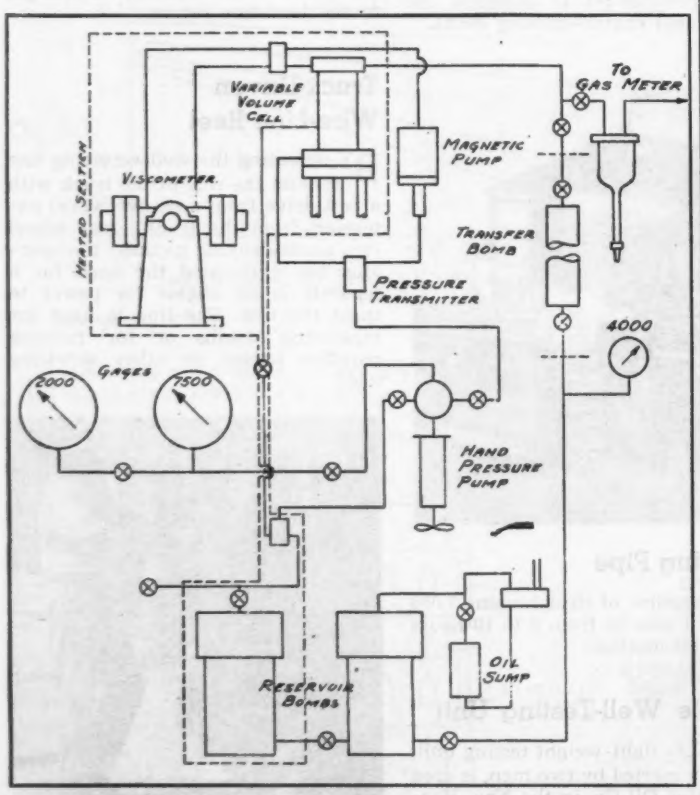

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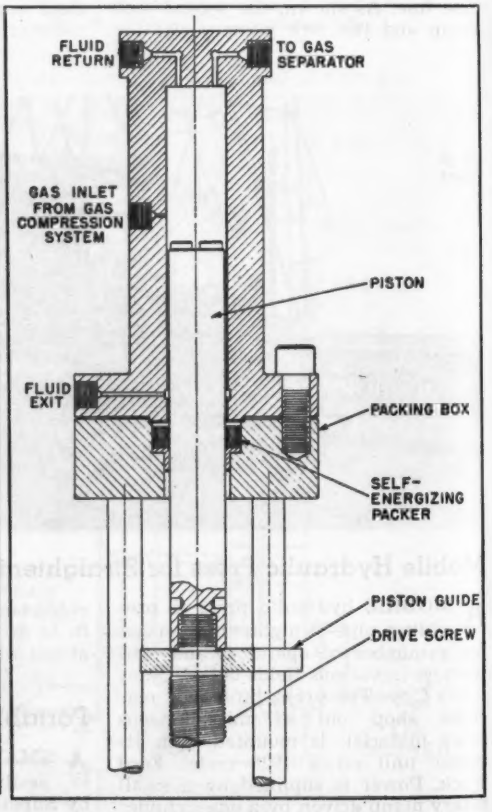

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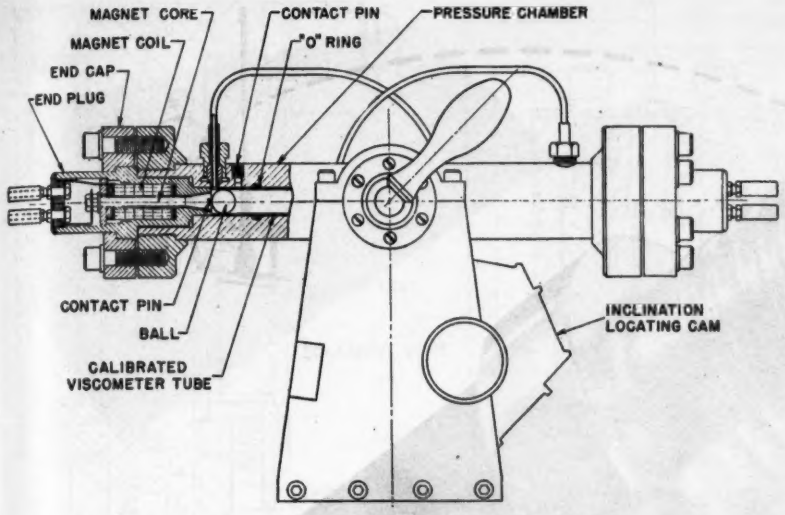

Fig. 3—Rolling-ball viscometer

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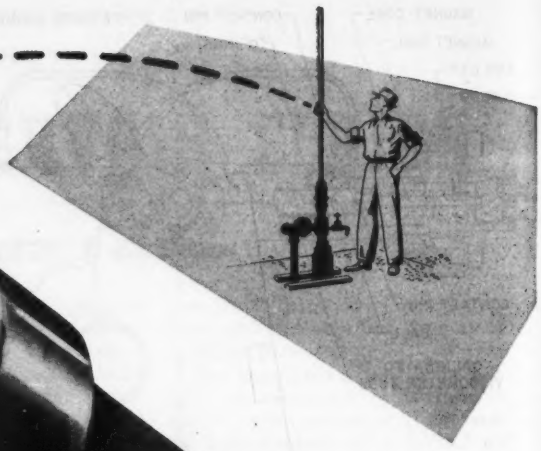

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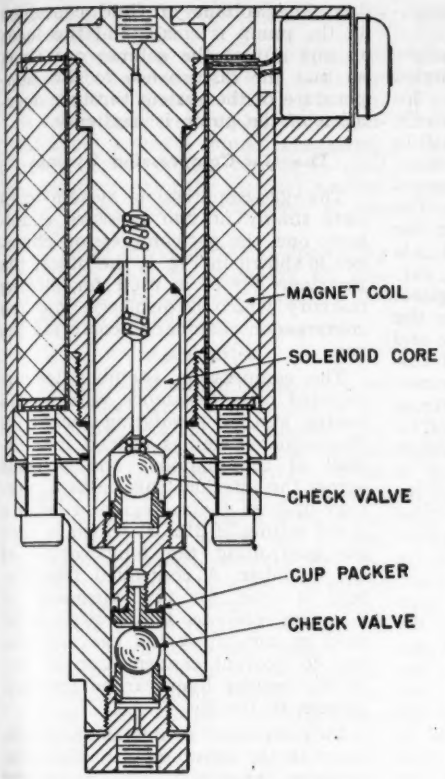

Fig. 4—Magnetic pump

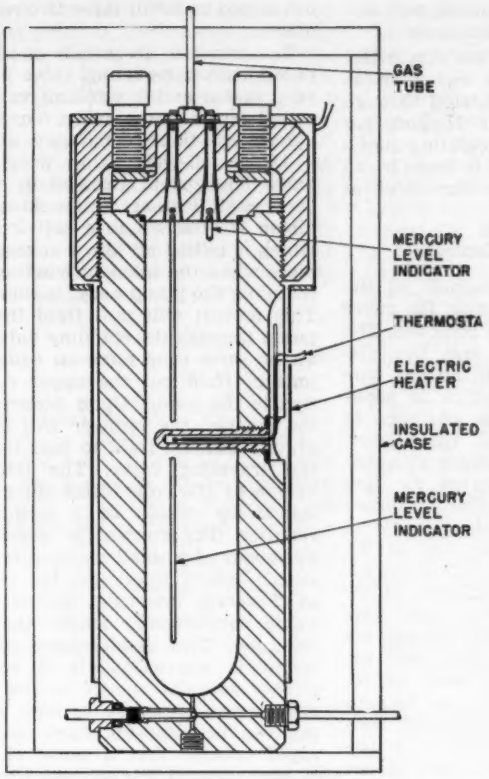

Fig. 5—Reservoir bomb

In practice, the counter is set to indicate the actual volume of the piston for a given piston position so that, subsequently, the true value can always be read from the counter. The counter indicates volume to 0.01 cc.

The design of the packer offered the greatest difficulty of any component in the variable volume cell. The requirements for the packer are very stringent in that it must be absolutely leakproof for both gas and oil at pressures up to 6,000 psi., and temperatures as high as 350° F. Tests of commercial packing arrangements and compounds soon showed that they would be entirely inadequate for such service. The solution of the problem was found in the self-energizing packing having a "U" cup suction. This design was found to be satisfactory at low temperatures, and any one of a number of different synthetic rubber compounds was used. The maximum temperature at which the best of these compounds could be used was approximately 235° F. Above this temperature, the material tended to reform and to vulcanize to the piston and to the packing compartment. The only material found to withstand higher temperatures was Teflon, a recent duPont development. While this material has successfully met all the temperature and pressure requirements, it does not have the resiliency of the synthetic-rubber compounds and requires extreme care in its manufacture and use. It has been our practice to use neoprene packers where temperatures do not exceed 200° F.

Rolling-Ball Viscometer

The rolling-ball viscometer shown in Fig. 3 is a modification of that previously described by Exline and En-Dean.[10] Design modifications have been incorporated in the present instrument to secure greater reliability and trouble-free operation.

The instrument consists essentially of a tubular pressure chamber containing a precision bore glass tube through which a steel ball can roll with a known clearance. The ends of the pressure chamber are closed by end plugs, each containing a solenoid magnet whose core communicates with the interior of the chamber and is electrically insulated from the chamber. With the ball held in contact with one of the end plugs by the magnetic field, it completes an electrical contact from the end of the magnet, through the ball to the metalized end of the glass tube and thence to a spring contact in the wall of the chamber. Completion of this electrical circuit energizes an electronic relay which, in turn, controls a timing clock. The connection is such that the timing clock operates only when the contact circuit is open. In operation, the instrument is given a definite angular displacement by forcing one end of it against a cam which can be set to secure any one of four fixed angles. A switch is is thrown deenergizing the upper magnet holding the ball which is then free to roll down the tube. As it leaves the contact, the electronic relay circuit is opened and a timing clock caused to start. When the ball traverses the length of the tube and strikes the lower contact, the clock is thereby stopped, giving the reading of the roll time.

The principal design change in the instrument proper is the use of a precision bore glass tube as the viscometer tube rather than depending on the inner bore of the pressure chamber for this purpose. In the past, difficulty had been encountered in making a precision bore to closely duplicate another tube. Since a number of these units were to be constructed, it was felt desirable that they all have interchangeable parts and that the calibrations be as nearly identical as possible. Since a large number of glass tubes can be formed over a single mandrel, their diameters can be held very closely to the same dimension without excessive expense. In the present design, the bore of the pressure chamber is drilled somewhat larger than the outside diameter of the glass tube. In order to prevent leakage of fluid between the tube and the bore of the pressure chamber, an annular groove is machined to take a synthetic rubber "C" ring which would fit closely over the tube, making a perfect seal.

Electrical conductivity from the ball to the tube is obtained by metalizing the inner, outer, and end surfaces of the glass tube for a distance of a little more than half of the diameter of the ball from the end of the tube. This metalizing is a recent development of Corning Glass Co. and is done by them. A spring-loaded contact pin is located in the wall of the pressure chamber near each end so that the ball point presses firmly against the metalized end of the glass tube, thus facilitating continuity of the electrical circuit.

Other modifications of the original instrument include removing the jacket for circulating the temperature-control liquid and the insulation. This was done as it was found an air bath

was much more convenient and satisfactory for temperature control.

Fluid connections to the viscometer are located near each end plug so that fluid can be circulated through the viscometer without trapping gas bubbles. While the circulating pump is operating, the tube is kept in an inclined position with the inlet at the lower end.

Temperature Control

Fig. 6 shows a photograph of the rear of the apparatus with the cover of the insulated cabinet removed. The variable volume cell and the viscometer can be seen in the left portion of the cabinet which is separated from the plenum chamber to the blower by a baffle. The blower, which is driven by a motor mounted outside the cabinet, forces air into a duct containing a series of finned heaters, having a total capacity of 2,500 watts. The lower side of the duct contains a number of louvers for securing improved circulation of air in the chamber. An adjustable thermostat protrudes into the cabinet for controlling the temperature and the bulb of a thermometer, used for indicating the temperature, can be seen directly above the thermostat. Improved temperature control is obtained by placing but a part of the heating load on the thermostat. The voltage to the remainder of the heaters can be controlled by a variable-voltage transformer. Although the air temperature quickly reaches that for which the thermostat is set, its low heat-transfer coefficient requires that an hour or more pass before the heavy metal parts of the test elements reach that temperature. Once the correct temperature of the apparatus has been attained, any temporary disturbances of the air temperature are not perceptible in the temperature of the variable volume cell or viscometer.

Use of an air bath is preferable to an oil bath in that the parts are much more easily accessible, and higher temperatures can be reached without objectionable fumes or the danger of fire.

Magnetic Pump

In quantitative analyses of this type where pressure and volume changes are produced in a system containing liquid and gas in contact, it is essential that a means of stirring or agitation be provided to assure equilibrium between the two phases. When the testing is conducted with a pressure system comprising interconnected pressure vessels, the most practical method of obtaining equilibrium is that of circulating the test fluids. Any circulating device used must be absolutely pressure tight and must cause no volume change of the system by its operation. The magnetic circulating pump shown in Fig. 4 was developed to fulfill these two requirements.

The pump is essentially a plunger pump with a traveling valve carried on a piston and a standing valve located in the pump body. The check valves are those commonly used in a 1⅛-in. oil-well pump with ⅝-in. balls. The piston is sealed by means of a small leather cup packing. The piston is attached to a soft iron bar which is pulled up into a conical pole piece when the solenoid winding, surrounding the pump body, is energized. This motion will pull fluid into the pump through the standing valve and at the same time force an equal volume of fluid out the upper connection to the pump. Upon deenergizing the magnet, the plunger will fall by gravity causing fluid to pass through the traveling valve. The pump is driven by 100 volts direct current obtained by means of a commercial rectifier. The current is interrupted by means of a small motor-driven tip switch which interrupts the current at 2-second intervals, the off time being substantially longer than the on time. The displacement of the pump is approximately 3 cc. per stroke, and the energy is such that differential pressures as high as 300 psi. can be built up. Each stroke is rapid enough that a pulse of fluid is sent around the system and jets into the variable volume cell with considerable velocity, thus stirring the liquid contained there.

The magnetic pump is mounted outside the insulated cabinet to avoid overheating and damage to the winding. The volume of fluid contained in the pump is small, and the leads in and out of the cabinet are short so that the disturbance to the temperature of the system through operation of the pump is negligible.

The Gas-Compression System

The gas-compression system consists simply of two pressure chambers; one, the gas-compression chamber is shown in Fig. 5, the other, the reservoir bomb, is used for storing mercury which is displaced into the compression chamber to compress the gas.

The compression chamber is surrounded by a resistance wire-wound heater and an insulating jacket. A thermometer well is welded into the wall of the chamber and projects across the interior. This holds a mercury-in-glass thermoregulator with a fixed setting of 212° F. which is used for controlling the temperature of the chamber. A controlled temperature is used for two purposes; as a known reference temperature to be used in computing the gas volumes, and to prevent condensation of any of the heavier hydrocarbon fractions present in the gas.

Two insulated contact pins are located in the cover plate of the compression chamber; one extending nearly to the bottom, and the other terminating just below the cover. These are used for locating the mercury-gas interface, and the volume contained between two horizontal planes just touching the terminal

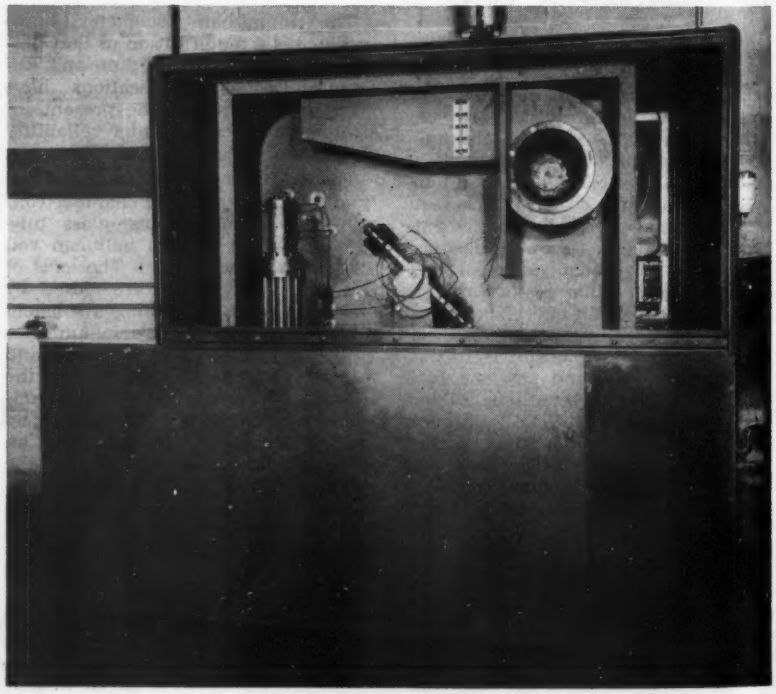

Fig. 6

points of the contact pins must be accurately known.

The reservoir bomb is of identical construction except that it does not have a thermometer well, being used at room temperature. Its cover contains but a single contact pin, terminating close to the top. It is used to indicate when the mercury reaches its highest permissible level in the bomb.

A small motor-driven reciprocating pump is used for pumping oil into the top of the reservoir bomb to displace the mercury.

Accessories

Tubing.—All tubing connections are either ¼-in. o.d. by $\frac{1}{16}$-in. i.d. or ⅛-in. o.d. by $\frac{1}{16}$-in. i.d. The heavier tubing is used wherever possible because of its rigidity. Where flexibility is required, as in the leads to the viscometer, the lighter tubing is used. Since the viscometer must be rotated through an angle of over 90°, the leads are bent into spirals centered about the axis of rotation to secure sufficient length to keep the bending stresses down to a safe value.

All end connections are identical, the smaller tubing having a ¼-in. o.d. by ⅛-in. i.d. by 2-in. long sleeve welded over each end. Each end is turned to a 60° cone and threaded with ¼-in. 28 left-hand thread for ½-in. A connector nut is slipped over the tubing and a small cellar threaded on the end. When the connector nut is screwed into the female fitting, the conical end of the tubing is forced into a mating cone, providing a metal to metal seal of small area. This design of connection was first developed at a fixed nitrogen laboratory and is now finding widespread use due to its reliability and simplicity. A joint may be made and broken many times without affecting its performance.

Gasometer.—The gasometer, for measuring the volumes of gas removed from the pressure has been described.[3] It consists of a cylindrical holder having a reentrant bottom which forms an annular space. This space is filled with mercury which acts as the sealing fluid. An inverted bell is suspended by a thin metal tape which passes over a pulley to a counterbalance weight. The side of the pulley toward the weight is cut in a spiral so that as the bell rises the weight moves farther from the center of the pulley, thus compensating for the decrease in buoyancy as the immersion in mercury decreases. A semicircular scale on the pulley indicates volume in cooperation with a vernier attached to the supporting post. The total capacity of the gasometer is 0.150 ft.,[3] which can be read to 0.0001 ft.[3] by means of the vernier.

Calibration.—The volumes of all parts of the system must be accurately determined. If the piston of the variable cell is accurately made, as it must be, this is a relatively simple process. The piston is retracted to its lowest position, the counter set to any arbitrary value, V_0, and the system filled with dry nitrogen to pressure, P_1, usually 200 or 300 psia. The piston is then run in an arbitrary amount, ΔV, and the new pressure reading, P_2, taken. Since nitrogen is not an ideal gas, its deviation from ideal behavior must be taken into consideration. If Z_1 is its deviation factor at P_1 and the temperature of the experiment and Z_2 its deviation factor at P_2 and the same temperature, then:

$$\frac{P_1V_1}{Z_2} = \frac{P_2V_2}{Z_1} \qquad (1)$$

In this equation, V_1 is the total volume of the system with the piston in its initial position, and V_2 the volume with the piston in its final position. However, $V_1 - \Delta V = V_2$ which can be substituted in Equation 1 to give:

$$\frac{P_1V_1}{Z_2} = \frac{P_2(V_1 - \Delta V)}{Z_1} \qquad (2)$$

Solving this equation for V_1 gives:

$$V_1 = \frac{\Delta V}{1 - (P_1Z_1/P_2Z_2)} \qquad (3)$$

In practice, successive readings are taken while inserting the piston in stages to as high a pressure as desirable. Measurements are also taken while withdrawing the piston, stopping at the same values of pressure observed on the upward trip. A discrepancy in the counter readings when returning to the initial pressure is an indication either of leakage or of a small temperature change. Table 1 shows a set of data taken during an actual calibration run, and the computed volumes. In each case, the initial readings were used for the starting conditions and the ΔV was taken as the total volume change to that point. The agreement between the volumes calculated at the different steps is unusually good, although the greater weight should be given to the determinations using the larger steps.

TABLE 1—VOLUME DETERMINATION OF VARIABLE VOLUME CELL

P = observed pressures—absolute
B = barometer pressure—29.21 in Hg.
Z = deviation factor of nitrogen at P
ΔV = volume change
V = calculated volume variable volume cell

P Obs. Psi.	Counter reading	ΔV	Z	V
243.75	997.10	2.90	.9974	.....
343.75	951.70	48.93	.9967	160.84
443.75	925.80	74.20	.9961	160.84
545.75	909.85	90.15	.9955	160.79
643.75	898.81	101.19	.9954	160.89
743.75	890.77	109.23	.9960	160.95
843.75	884.65	115.35	.9960	160.94
943.75	789.80	120.20	.9960	160.97
1,043.75	875.93	124.07	.9960	160.92
943.75	879.78	120.22	.9960	160.99
843.75	884.56	115.44	.9960	161.07
743.75	890.66	103.34	.9960	161.12
643.75	898.64	101.38	.9954	161.18
543.75	909.57	90.43	.9955	161.30
443.75	925.47	74.53	.9961	161.57
343.75	950.56	49.35	.9967	162.28
243.75	996.51	3.49	.9974	.....

The only other significant calibration is that of the rolling-ball viscometer and this has been described elsewhere.[2] This is done by observing the roll times when using fluids of known viscosity and density of atmospheric pressure. The assumption is made that any alteration of the dimensions of the glass tube and of the ball due to pressure is negligible. Previously the calibration was shown as a series of curves with the absolute viscosity as ordinate plotted against $(T(\rho_b - \rho_L)$ as abscissa; where T is the roll time in seconds, ρ_b the density of the ball, and ρ_L that of the liquid. A different curve was given for each angle of inclination of the tube. However, in that work, both ball and tube were of metals having substantially the same coefficient of thermal expansion. When a glass tube is used, the coefficients of expansion differ materially and a second parameter, temperature, is encountered.

Recent work by the senior author

(Continued on page 91)

TABLE 2—CONSTANTS FOR USE IN VISCOSITY COMPUTATIONS

(Viscometer No. GLX-1049)

$$\mu = \frac{T(\rho_B - \rho_L)K}{1{,}000}$$

T = roll time, seconds
ρ_B = density of ball = 7.777 grams/cc.
ρ_L = density of liquid, grams/cc.
K = viscometer constant as computed from equations given below
t = temperature in °F.

Tube No. 1075

⅝ + 0.006-in. ball:
Position 2 ..... K = 12.60 — 0.00896 t
Position 3 ..... K = 8.70 — 0.00620 t
Position 4 ..... K = 6.505 — 0.00465 t
⅝ + 0.009-in. ball:
Position 2 ..... K = 5.775 — 0.00525 t
Position 3 ..... K = 3.980 — 0.00360 t
Position 4 ..... K = 2.980 — 0.00270 t
⅝ + 0.012-in. ball:
Position 2 ..... K = 2.160 — 0.00270 t
Position 3 ..... K = 1.482 — 0.00183 t
Position 4 ..... K = 1.112 — 0.00138 t

Tube No. 1078

⅝ + 0.006-in. ball:
Position 2 ..... K = 11.04 — 0.00820 t
Position 3 ..... K = 7.615 — 0.00565 t
Position 4 ..... K = 5.69 — 0.00420 t
⅝ + 0.009-in. ball:
Position 2 ..... K = 4.84 — 0.00460 t
Position 3 ..... K = 3.335 — 0.00315 t
Position 4 ..... K = 2.50 — 0.00240 t
⅝ + 0.012-in. ball:
Position 2 ..... K = 1.66 — 0.00220 t
Position 3 ..... K = 1.147 — 0.00152 t
Position 4 ..... K = 0.858 — 0.00114 t

Tube No. 1105

⅝ + 0.006-in. ball:
Position 2 ..... K = 11.77 — 0.00860 t
Position 3 ..... K = 8.12 — 0.00590 t
Position 4 ..... K = 6.075 — 0.00445 t
⅝ + 0.009-in. ball:
Position 2 ..... K = 5.27 — 0.00490 t
Position 3 ..... K = 3.64 — 0.00340 t
Position 4 ..... K = 2.71 — 0.00250 t
⅝ + 0.012-in. ball:
Position 2 ..... K = 1.88 — 0.00240 t
Position 3 ..... K = 1.295 — 0.00165 t
Position 4 ..... K = 0.973 — 0.00125 t

Regeneration of Spent Catalyst In Fluid Catalytic Cracking

by John F. Snuggs*

THE regeneration of spent cracking catalyst is accomplished by burning about 1 to 2 weight per cent of carbonaceous material from the catalyst under closely controlled operating conditions. During the combustion a large quantity of heat is produced. Regeneration supplies a portion of the heat required to support the reaction in the catalyst conversion zone, and excess heat is used to produce steam.

Descriptions of the oil, air, and catalyst flows in the several types of fluid catalytic cracking systems have been presented in many papers published during the past few years. The general description which follows is a brief review for the purposes of the present paper.

The process equipment comprising a fluid-catalyst unit can be divided into four principal sections:

1. Feed preheat section
2. Reaction section
3. Regeneration section
4. Product fractionation section.

*Research department, Standard Oil Co. (Ind.), Whiting, Ind. Article abridged from a paper presented at the A.S.M.E. spring meeting, Tulsa.

Fig. 1 is a schematic drawing showing these sections and may be referred to in tracing the process flow.

In the feed preheat section fresh charging stock (gas, oil, etc.) is heated in tubular heat exchangers with hot streams from the fractionator and, in some cases, by means of an oil or gas-fired furnace. Feed, either partially or completely vaporized, is directed to the regenerated-catalyst pickup point where it contacts hot, finely divided, solid catalyst particles. This mixture of oil and catalyst flows upward into the reaction section where the cracking reaction takes place. A fluidized bed of catalyst is maintained in the reactor.

During the cracking reaction a catalyst deposit, or coke, is formed on the catalyst. This material must be removed in order to maintain catalyst activity and selectivity. Spent catalyst is continuously drawn from the reactor and is directed through a steam stripping zone where entrained and volatile hydrocarbons are removed, and is then caused to flow through a standpipe. At the bottom of the spent-catalyst standpipe the catalyst meets a stream of air which carries it into the regeneration section. As the regeneration progresses, sufficient coke is burned from the catalyst to restore its activity, and the regenerated material is returned continuously to the cracking zone by means of another standpipe and the oil-transfer system.

Fig. 2 is a view of a commercial fluid cracking unit showing the orientation of the principal sections of the equipment. Feed-preheat exchangers are located to the right, the preheater furnace is at the left background. The smaller of the two vessels in the main structure is the reactor, the larger is the regenerator. The product oil fractionator and its auxiliaries are located at the extreme right of the structure. Behind the catalytic structure and not visible in the picture are other structures housing the control room, regeneration air compressor, cracked-gas compressors, and other auxiliaries.

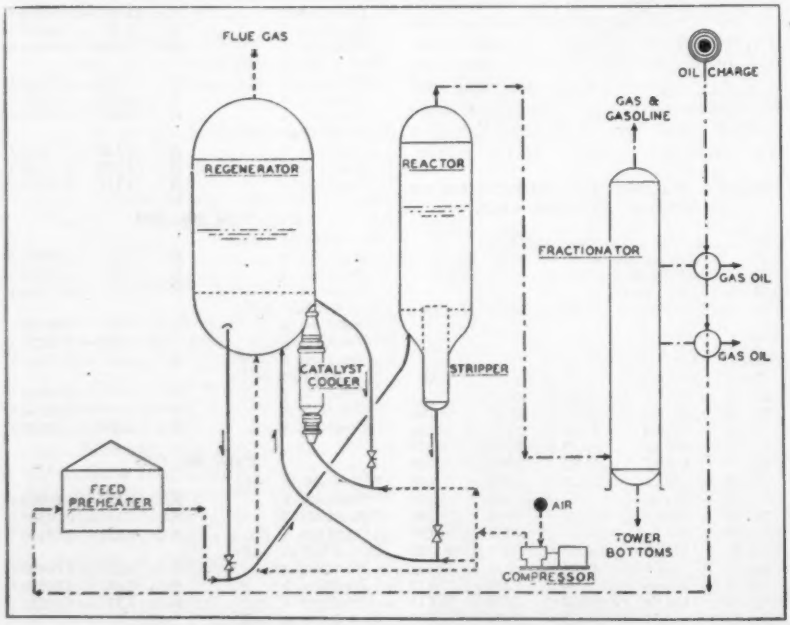

Fig. 1—Schematic arrangement of a fluid catalytic cracking unit showing the four principal sections of the equipment

Regeneration Variables

The principal variables affecting the design of a fluid catalyst regeneration system are:

1. Temperature of regeneration.
2. Type of catalyst.
3. Analysis of catalyst deposit.
4. Fraction of catalyst deposit removed during regeneration.
5. Contact of air and catalyst and catalyst residence time.
6. Regeneration pressure.

These factors are discussed in general below.

Temperature of Regeneration

Commercial fluid catalytic cracking units operate with regeneration temperatures ranging from slightly below 1,000° F. to about 1,200° F. The choice of operating temperature for design purposes is a balance among several factors. In general, the higher the temperature, the more readily the combustion occurs. On the other hand, at the highest temperature levels, permanent catalyst deactivation occurs at an accelerated rate, and construction problems and costs tend to become more important considerations. The type of catalyst to be employed is also to be considered, since some are more heat resistant as regards activity decline than others. Much study has been given these factors and their combined effects have been evaluated, with the result

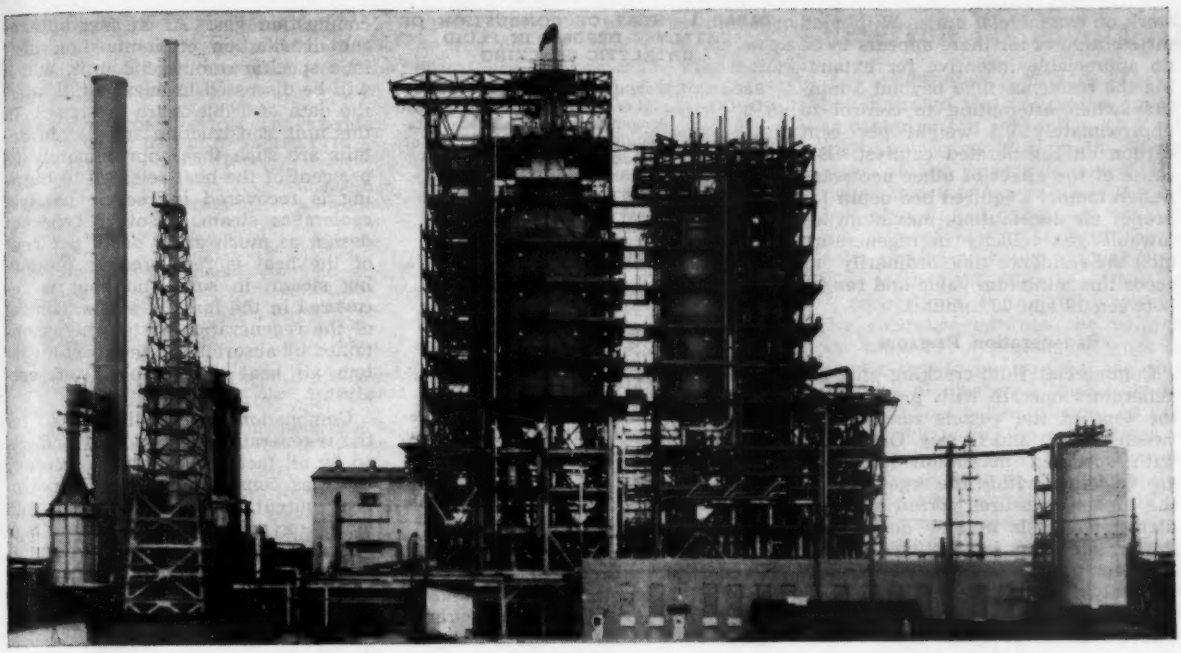

Fig. 2—A commercial fluid catalytic cracking unit showing orientation of the principal sections of the equipment

that current designs generally call for a regeneration temperature falling within the 1,025°-1,100° F. range.

Type of Catalyst

As mentioned in the foregoing, the type of catalyst to be used affects the design and operation of regeneration equipment because of temperature deactivation problems. The catalyst type will also affect regeneration-air requirements and heat evolution, since catalysts having different chemical composition result in various ratios of CO_2 to CO in effluent regeneration gases. With various commercial catalysts the CO_2 to CO ratio varies between about 50:50 to 65:35. The presence of certain metallic contaminants, such as iron, which may accumulate on the catalyst during operation, tends to increase the CO_2 to CO ratio, and results in increased air requirements for burning of any given amount of catalyst deposit.

Analysis of Catalyst Deposit

The coke, or catalyst deposit, which is to be removed from the catalyst during regeneration is composed principally of carbon and hydrogen, but may also include sulfur. The actual composition of the deposit is complex as regards hydrocarbon types and is not well known. Depending upon the adequacy of the spent-catalyst steam-stripping facilities, which are intended to remove entrained and volatile hydrocarbons leaving only coke, the carbon content of sulfur-free deposit varies from about 93 to 87 weight per cent and hydrogen content from about 7 to 13 weight per cent. (Hydrogen content calculated by nitrogen balance across the regenerator and determined by oxygen disappearance). Since about four times as much air is required to burn 1 lb. of hydrogen as is necessary for 1 lb. of carbon, the importance of adequate spent-catalyst stripping facilities and low hydrogen content in determining regeneration-air requirements is obvious. Normally, with a well-designed spent catalyst stripper, slightly less than 10 weight per cent of hydrogen in coke can be specified for design purposes. Heat of combustion and regeneration-air requirements for various CO_2 to CO ratios and hydrogen contents are covered in a subsequent section.

Fraction of Catalyst Deposit Removed During Regeneration

The weight per cent of catalyst deposit on spent catalyst charged to the regenerator varies between less than 1 to more than 2 per cent in commercial installations and is partially a function of the catalyst-to-oil ratio fed to the cracking zone. Regenerated catalyst contains from about 0.3 to 1.0 weight per cent of residual deposit after completion of combustion. A balance among several factors defines the coke level desired on regenerated and spent catalyst for any specific design. First, the burning of 1 lb. of coke from catalyst having a high deposit content generally proceeds more readily than the burning of the same amount of coke from catalyst having a low coke content. Second, it is desirable from the standpoint of the cracking reaction side of the process to maintain a relatively low catalyst carbon content. Third, high coke percentages on catalyst in the regenerator are not satisfactory, since catalyst entrainment in flue gas tends to become an increasingly important factor. In commercial operation, balancing between these factors has established the desirability of maintaining coke content of regenerated catalyst at between about 0.3 and 0.7 weight per cent by control of other operating variables.

Contact of Air and Catalyst and Catalyst Residence Time

One of the more important factors affecting the economical utilization of regeneration air is the provision of a suitable distributing device to promote adequate contacting of air and catalyst within the regenerator. Distribution of air, typically, is accomplished by means of a grid plate located at the bottom of the regenerator catalyst bed. This grid contains many small-diameter holes and imposes 0.5 to 1.0 lb. pressure drop to the air flow. It is also desirable to avoid a shallow catalyst bed within the regenerator through which mass channeling of air may occur. In large commercial units, at least 10, and preferably 15, ft. of regenerator bed depth are desired when the regenerator takes the form of a single bed.

Gas should flow through the regenerator at low velocity. Commercial designs call for about 1.5 ft. per second velocity, which is satisfactory from the standpoint of minimizing catalyst entrainment in the gas.

The residence time of catalyst within the regenerator has been varied over exceedingly wide ranges in test

work on commercial units. With good distribution of air there appears to be no appreciable incentive for extending the residence time beyond 5 minutes when attempting to control to approximately 0.5 weight per cent carbon on regenerated catalyst. Because of the effect of other necessary design factors (required bed depth for proper air distribution, maximum allowable gas velocity in regenerator, etc.) the residence time ordinarily exceeds this minimum value and ranges between 10 and 20 minutes.

Regeneration Pressure

Commercial fluid-cracking-unit regenerators operate with pressures at the tops of the vessels ranging between about 1 and 13 psig. Obviously, with specified maximum allowable gas velocities within the regenerators, the higher pressures permit smaller-diameter vessels in new designs, or greater air flows in existing units. It has been shown that the combustion of catalyst deposit proceeds more favorably at the high-pressure levels. The choice of pressure used weighs these factors and others against the increased cost of compressing large amounts of air to the higher-pressure levels.

Heat Release and Air Requirements

The amount of heat released in the burning of carbonaceous material transferred with catalyst from the reactor to the regenerator is influenced by the several factors which control regeneration operation. For design purposes, the amount of heat released per pound of catalyst deposit burned can be calculated from the expected flue gas analysis, hydrogen content of coke, etc., each of which follows the general concepts mentioned above under "Regeneration Variables." Table 1 summarizes net heat of combustion values for several possible conditions.

TABLE 1—HEAT OF COMBUSTION OF CATALYST DEPOSIT IN FLUID CATALYTIC CRACKING

Ratio CO_2/CO in combustion gas	Weight per cent of hydrogen in catalyst deposit*	Net heat of combustion of deposit burned from catalyst—B.t.u./lb. of deposit
50:50	8	12,440
65:35	8	13,840
50:50	12	14,140
65:35	12	15,480

Basis: Reaction	Net heat of combustion B.t.u./ lb. of H or C
$H + \frac{1}{4} O_2 \rightarrow \frac{1}{2} H_2O$	51,650
$C + O_2 \rightarrow CO_2$	14,100
$C + \frac{1}{2} O_2 \rightarrow CO$	3,960

*Measured by oxygen disappearance in regenerator as determined from Orsat analysis and nitrogen balance.

It is to be noted that the weight per cent of hydrogen in catalyst deposit is designated as that amount determined by oxygen disappearance calculations based on Orsat analyses and nitrogen balance. Oxygen is probably also consumed in the regenerator oxidizing metallic impurities which are in the catalyst. In some cases account is taken of this factor, but in most instances it is neglected due to lack of specific knowledge as to the magnitude of the adjustment to be applied.

Net heat-of-combustion values are used in establishing an over-all heat balance around the regeneration system. The amount of heat which must be removed in the form of steam is determined by difference after determining the amount of heat transferred to the reaction zone due to the rise in catalyst temperature in passing through the regenerator and the net heat leaving the regenerator in combustion gas. As an example of the distribution of combustion heat in a specific commercial unit, which will be discussed in more detail later, the data of Table 2 are presented. In this unit, construction and design details are such that approximately 53 per cent of the heat released in burning is recovered in recycle catalyst coolers as steam. In other types of design as much as 65 or 70 per cent of the heat is recovered in producing steam; in some, no heat is recovered in the form of steam, control of the regeneration system being obtained by absorbing in the reactor system all heat recoverable from catalyst.

Combustion-air requirements for the regeneration operation are affected by all factors which influence dry flue gas composition, by the hydrogen content of catalyst deposit, and by the oxygen content of effluent flue gas required for control. Table 3 summarizes air requirements calculated for various ratios of CO_2/CO in flue gas, various hydrogen contents of the

TABLE 2—DISTRIBUTION OF REGENERATION HEAT IN A COMMERCIAL CATALYTIC CRACKING UNIT

	Millions of B.t.u./hr.	Per cent
Heat released	238	100
Heat in flue gas (over entering air)*	56	23
Heat to reaction zone	36	15
Heat to steam	125	53
Heat loss and unaccounted for	21	9
Total	238	100

Basis: Operations shown in Table 4. Net heat of combustion of coke is 13,840 B.t.u. /lb at 8 per cent hydrogen. Reaction zone at 900° F. Steam produced at 160 psig. from 300° F. boiler feed water.

*Approximately 50 per cent of this heat potentially recoverable in a flue gas boiler, bringing steam to 153 millions of B.t.u./hr. or 64 per cent of heat release.

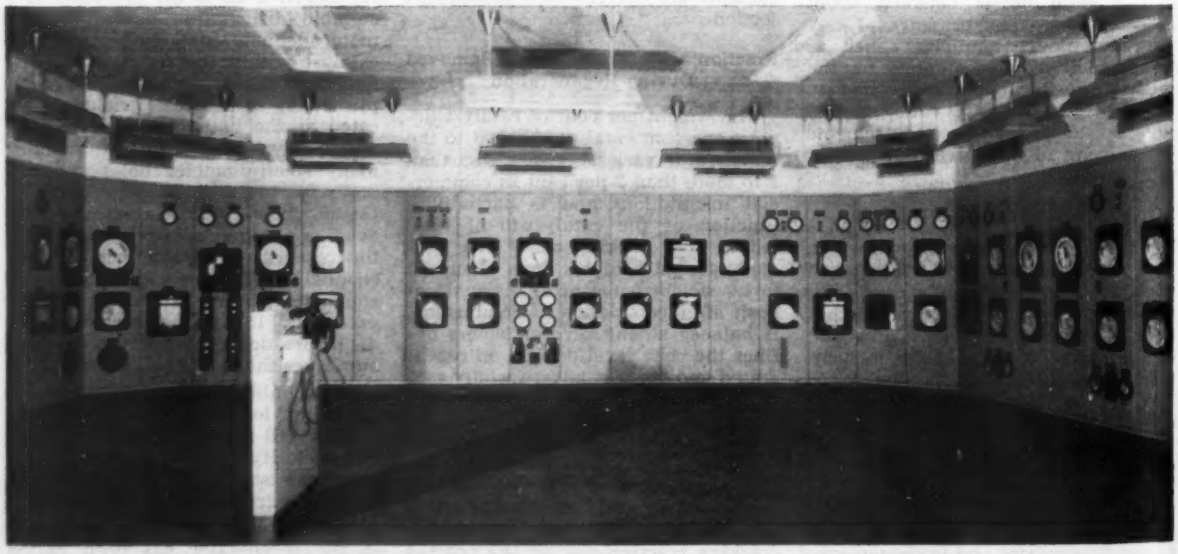

Fig. 3—Control panel for a fluid catalytic cracking unit's regeneration facilities

coke, and for 2 per cent oxygen in flue gas. Actual practice confirms closely the stoichiometrically calculated requirements.

TABLE 3—COMBUSTION AIR REQUIREMENTS, IN FLUID CATALYTIC CRACKING

Ratio CO_2/CO in combustion gas	Weight per cent of hydrogen in catalyst deposit*	Combustion air requirement—Lb. air/lb. deposit burned
50:50	8	12.05
65:35	8	12.92
50:50	12	13.18
65:35	12	14.02

Basis: 2 Per cent oxygen in dry effluent flue gas. Air supplied at 100° F., 50 per cent relative humidity.

*Measured by oxygen disappearance in regenerator as determined from Orsat analysis and nitrogen balance.

Many variations in regeneration control technique have been used in fluid catalytic cracking units. The system described in the following is typical of practice used in several instances.

The flow of spent catalyst from the spent catalyst standpipe, and the consequent load imposed upon regeneration facilities, is regulated by means of a slide valve. The opening of the valve is automatically controlled by positioners which are controlled by the level of catalyst in the reactor. A specified catalyst level is maintained in the reactor so that cracking severity, and coke production, are maintained constant.

The air used to transport catalyst from the bottom of the spent catalyst standpipe to the regenerator is flow controlled at the quantity which will give suitable flow characteristics and maintain satisfactorily low burning rate in the carrier line. Additional combustion air enters the regeneration zone through the recycle-catalyst-cooler system and through auxiliary air lines. Each of these flows is also controlled at desired rates. The speed of the air compressor supplying combustion air is regulated by a controller which gives constant pressure at the discharge of the machine.

Temperature in the regenerator catalyst bed is maintained at a specified level by circulating hot catalyst through a standpipe, through a cooler, and then back to the regenerator. The rate of catalyst circulation through the cooler is automatically regulated by temperature controllers which actuate slide valve positioners. Two circulating loops are used on large units.

In regeneration operations it is possible under certain conditions for the carbon monoxide formed during the combustion to burn to carbon dioxide near the top section of the vessel, where catalyst concentration is low. When this occurs, very high temperatures result. In order to protect the regeneration equipment, use is made of emergency water sprays which are directed into the burning gas and, at times, into the catalyst bed. Flow of emergency spray water is controlled to the desired quantity while steps are taken to eliminate the factors leading to the upset condition.

The pressure at the outlet of the regenerator may be automatically or manually controlled. In case of automatic control, a pressure tap at the top of the regenerator is the control point for a valve positioner which adjusts the opening of a valve throttling the flue gas flow.

For economical use of combustion air, it is desirable to maintain only a slight excess of oxygen in the regenerator flue gas. A visual record of oxygen content of this stream is obtained in many units by means of an oxygen recorder which samples at the regenerator outlet. As a further check upon operations, samples of flue gas are regularly obtained for determination of carbon dioxide, oxygen, carbon monoxide, and inerts by Orsat analysis.

Fig. 3 is a view of a control panel where the principal instruments used in connection with the regeneration facilities are grouped. In addition to the controllers, recorders, and indicating devices shown, supplementary instruments are located elsewhere for control of the air compressor, recycle-catalyst-cooler feed-water system, and other auxiliaries.

Table 4 summarizes some design and operating data for a commercial fluid-cracking-unit regenerator. It is to be emphasized that this tabulation illustrates operation of a specific installation and that the data are not typical for all units. For other units, in addition to variations in design details, the operating conditions may differ considerably from those shown. The unit under consideration is an installation designed for low catalyst circulation rate between the reactor and regenerator and for moderate regeneration temperature, and has a recycle catalyst cooler for control of regeneration heat balance.

TABLE 4—REGENERATOR OPERATION IN A FLUID CATALYTIC CRACKING UNIT

Design details—	
Vessel diameter	36 ft., 6 in. i.d.
Shell length	40 ft., 0 in.
Heads	Hemispherical
Top elevation	150 ft.
Shell and heads	Carbon steel
Operating conditions—	
Pressure at top of vessel	9 psig.
Catalyst bed temperature	1,025° F.
Entering air temperature	230° F.
Catalyst bed depth	18 ft.
Catalyst bed density	20 lb./cu. ft.
Spent catalyst charge	540 tons/hr.
Air supplied	220,000 lb./hr.
Gas velocity at top of vessel	1.45 ft./sec.
Carbon on spent catalyst	1.80 wt. per cent
Carbon on regenerated catalyst	0.35 wt. per cent
Coke burned (8% hydrogen)	17,200 lb./hr.
Flue-gas analysis (dry)	
CO_2	12.0 vol. per cent
O_2	2.0 vol. per cent
CO	5.8 vol. per cent
Inert	80.2 vol. per cent
Steam produced	135,000 lb./hr.

Reservoir Fluids Analysis

(Continued from page 87)

has indicated that it may be possible to construct the calibration of a rolling-ball viscometer from the dimensions of the apparatus alone. It is hoped that this can be made the subject of a future paper and that, for the sake of brevity, one of the results can be accepted without proof. This is that the velocity of the ball is proportional to the third power of the clearance between the ball and the tube. The experimental work has shown this to be true for the small changes of clearance caused by differential thermal expansion. As a result of this work, the calibrations are now expressed as a series of equations which include the temperature as a variable and the angle of inclination as a parameter. A group of such equations is shown in Table 2. The four positions indicate the four possible angles of inclination, and for each angle an equation is given for three sizes of balls. The tube diameter is 0.640 in.

The method of introducing the sample into the pressure system needs no additional description here nor does the technique of recombining surface samples which has been adequately described by Botset and Muskat.[8] The sole purpose of the paper has been to describe the design features of the apparatus.

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Deep-Well Camera

(Continued from page 75)

high in one side forming the picture window. The ground ends of the glass are sealed by means of neoprene gaskets against the steel head and steel nose piece which are screwed into the steel sleeve. These joints are subjected to only small differential pressures because of the equalizing action of the bellows in the nose piece. Attached to the head is the glass mirror making an angle with the vertical somewhat less than 45°. The mirror is shaped elliptically to fit inside the glass cylinder and has its back surface silvered. In the top of the head is the glass pressure window sealed with a thin rubber gasket to withstand the high pressure in the water chamber.

The head carries two G.E. No. 1129, 21-c.p. automotive-type lamps which are operated on 6 volts 60 cycle a.c. The exact position of the lights and the shape of the reflectors and shields were chosen to give good illumination of the subject while avoiding reflections in the mirror and glass cylinder, which might otherwise show up as bright spots in the picture.

The camera is screwed to the top of the water chamber head with its lens directly above the pressure window. The camera housing slides down over the camera making a pressure-tight threaded connection with the water chamber head. This joint is the one that is taken apart whenever the camera is loaded or unloaded.

The camera itself is a revamped Bell & Howell Model 151 magazine-loading 16-mm. movie camera with a 7.4 by 10.3-mm. frame size. This camera has a builtin feature permitting it to take single exposures like any still camera. The control button has been coupled to a solenoid for remote electrical control. The power for driving the film still comes from the camera's spring motor which will give 450 exposures on one winding. A 15-mm. focal length lens is used and provision has been made for stopping the lens down as small as f/32 if desired for greater depth of field. At f/32 an exposure time of 8 seconds is satisfactory when using Eastman negative panchromatic safety film.

The upper end of the camera housing is threaded to make a water-tight connection to the socket on the end of the electric cable. Below this connection is a "fishing stub" to facilitate retrieving the camera from a well in case of accident. A transformer fixed in the upper end of the housing provides the 6 volts required by the lights. When the housing is in place, two spring contacts below the transformer engage contacts on the upper end of the camera providing connections to camera and lights.

Two springs with the upper ends fixed at the camera housing and their lower end attached to a sliding block hold the camera against the formation in wells up to 12 in. diameter. By removing the springs, the camera which is 4⅞ in. diameter can be used in a hole as small as 4½ in. diameter.

Field Technique

When a well is to be photographed, it is first necessary to determine the type of fluid covering the section of formation where the pictures are to be taken. Most wells which produce formation water will have reasonably clear fluid covering the formation. If there is some doubt as to the type of fluid in the hole, a sample can be obtained by running a thief or bottom-hole sampler. If it turns out that the hole is filled with oil or with water too turbid for good pictures, it will be necessary to replace the well fluid with a relatively clear fluid. This is easily accomplished by spotting the clear fluid, usually salt water, in the well bore through tubing. The tubing is then removed from the well in order to run the camera.

In case the well is a flowing well then it should be killed before attempting to run the camera. By using a clear fluid to kill the well, it is possible to both kill the well and condition the bore hole so that optimum conditions exist for the taking of pictures, in one step.

On wells that have a layer of oil on top of the clear fluid covering the section to be photographed it is necessary to cover the window of the camera with a material which is very soluble in water but insoluble in oil. This is done so that any drops of oil that might cling to the window of the camera will be released when the material dissolves in the water and thus the window will be clean when the camera reaches the section of the well which is to be photographed.

The equipment used to operate the camera includes a special nonrotating stranded steel cable, the core of which is a rubber-covered electrical conductor. The metal sheath of the cable serves as the path for the return circuit. This cable is attached to a hoisting winch which has commutator rings enabling the cable to be raised and lowered in the well bore without breaking the elecrical circuit. A portable 110-volt a.c. generator and an instrument panel containing a voltmeter and an ammeter with suitable control switches for operating the camera are also provided. This equipment is all mounted in a truck so arranged that the truck motor drives the hoisting winch. The depth of the camera in the well bore is determined at all times by running the cable over a measuring wheel which is connected by Selsyn motors to a depth counter on the operating panel of the truck.

Each roll of film is identified by taking a photograph of a card containing the roll number, date, well name, and other pertinent data. This serves also as a check on the electrical circuit and the operation of the camera and lights.

The camera is lowered into the well at a rate of approximately 50 ft. per minute. The exposure time is controlled from the truck by the length of time that voltage is applied to the cable. This can be done with a manually operated switch or with an automatic time switch.

Two types of picture surveys are made: (1) A continuous strip photograph of the well bore showing every inch of the formation, and (2) a series of single-shot pictures spaced at intervals of 1 ft. or any other interval desired. The continuous strip picture is made by lowering the camera only 2 in. between exposures and then using only the center section of each print. The prints are fitted together to make a continuous picture of the well bore in much the same manner that aerial photographs are fitted together to make photomaps.

Future Developments

In some gas wells, the collection of dust on the picture window during the descent of the camera may present a difficulty not encountered in liquid-filled wells. To overcome this difficulty a camera has been built with an extra steel sleeve which slides over the water chamber and camera housing covering the picture window. When the camera reaches the point in the well where pictures are to be taken, the sleeve is released electrically and slides down far enough to bring a hole in the sleeve into register with the picture window. This device appears very workable but has not been field tested.

In the discussion of the general principles involved in the design of these deep well cameras, it was pointed out that the use of as large a water chamber as the well bore would permit was an advantage because the size of the area photographed at each exposure could thereby be increased, and also because a better fit between picture window and well bore could be attained. A logical step in this direction might be to build a series of water chambers of different diameters with the upper heads designed to connect to the same standard small-diameter camera housing.

Reinhold[1] ran his camera into shallow wells on a string of tubing and was thereby able to orient the camera to take pictures in any desired direction, this direction being indicated on the film by a compass located in the field of views of the camera. To orient the apparatus when supported by a cable is somewhat more difficult. Even with a slight deviation of the axis of the bore hole from the

vertical there is a strong tendency for the camera to twist around so that it consistently faces the low side of the hole with the "push over" springs facing the high side. Pictures taken in the same well on different trips usually show the same views because of this tendency of the camera to orient itself.

Many schemes have been suggested for taking pictures in all radial directions in the bore hole. One that looks promising is to use a cylindrical or bowl-shaped picture window extending completely around the circumference of the water chamber, omitting the mirror and using a very wide-angle camera lens. Another method would be to substitute for the plane mirror, a cone-shaped mirror or a submarine-periscope-type mirror with its axis vertical. The distortion produced by such a mirror could be canceled out by using the same optical system in reverse for projection printing or projection viewing of the developed film. One rather simple method of taking pictures in different directions would be to use a plane 45° mirror as in the present cameras, but provide a means, perhaps a motor or a solenoid, for rotating the mirror progressively a small amount around a vertical axis each time the film is advanced.

Related to the above problem is the one of taking pictures in stereoscopic pairs for stereoscopic viewing. The sense of perspective afforded in this way should be useful in studying porosity, cleavages, and general structure of the formation. The usual method of taking the two views from slightly different lens positions would be applicable here. In this case, rotating the mirror is equivalent to shifting the lens position. Thus for stereoscopic pairs it would only be necessary to take two separate pictures at each camera location, rotating the lens through a small fixed angle between the two exposures.

Another idea offering real possibilities is the one of replacing the photographic camera by a television camera transmitting to the surface where the subject viewed by the camera would be immediately and continuously visible on a screen. This subject has been thought about by many people. Wired television techniques now being employed industrially for observations of remote locations should be applicable here. A concern[2] specializing in such equipment is now engaged in developing deep well television equipment.

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2. Diamond Power Specialty Corp., Detroit.

"Wetting" Type Fire Extinguisher

by Henry W. Boggess*

FROM a study of the chart giving characteristics and uses of fire extinguishers, published in The Oil and Gas Journal, February 8, 1947, it will be noted that there are three kinds of hand-type extinguishing agents that may be classed as having a cooling (wetting) effect on fire:

1. Carbon tetrachloride (CCl_4)
2. Soda acid
3. Foam

Two of these three agents also have blanketing effect, CCl_4 and foam, but because of their cooling values should be grouped with those whose chief effect is to reduce the burning substance to a temperature below its kindling point.

The first of these three, CCl_4, is a very commonly used agent because of the fact that it can be stored in a small and handy extinguisher (usually 1 qt.) and also because it actually does have at least some degree of efficiency on all four classes of fire. Trouble may be encountered with CCl_4 extinguishers when an impure liquid is used. Ordinary commercial grades of carbon tetrachloride may not have a component for depressing the freezing point and

usually lack sufficient refinement to minimize corrosion of pump parts. The chief value of CCl_4 lies in the free gas which is produced when the liquid contacts heat and fire. This gas may contain phosgene which is lethal and it should never be used in confined spaces when air is without circulation, and static. Another drawback to its industrial use lies in the fact that carbon tetrachloride is one of the best known cleaning agents and is frequently pilfered for that purpose leaving only an empty container that gives a false sense of security and ensuing conflagration if depended upon.

Soda acid is perhaps the poorest of all listed extinguishers. Actually, it is merely water which is expelled under pressure up to about 110 lb. The most commonly used size, 2½ gal., is wholly inadequate to extinguish any but the simplest kind of fire in its incipient stage. Soda acid extinguishers will freeze and have value only on one of the four classes of fire: Class "A" (wood, textiles, rubbish, etc.).

Foam is an extensively used agent and merits serious consideration as a fire guard for many hazards. One 2½-gal. extinguisher expands to 20 gal. of foam which will blanket a considerable area, cooling burning substances as the fire is smothered. The chief criticism to foam is the fact that it must be constantly protected from freezing and that it is more or less immobile and cannot be used at any point where motion may cause a mixing of the ingredients and the consequent loss of the agent.

All three agents herein discussed can be quickly and conveniently recharged on the job but none of them presents as high a factor of security per dollar invested as the two agents discussed in the Journal on February 22: CO_2 and dry powder. In most cases, it is well to consider using a minimum of two types, one for blanketing and one for cooling in order to have a well rounded protection.

*Superintendent Employment - Insurance Safety, Sinclair Prairie Oil Co.

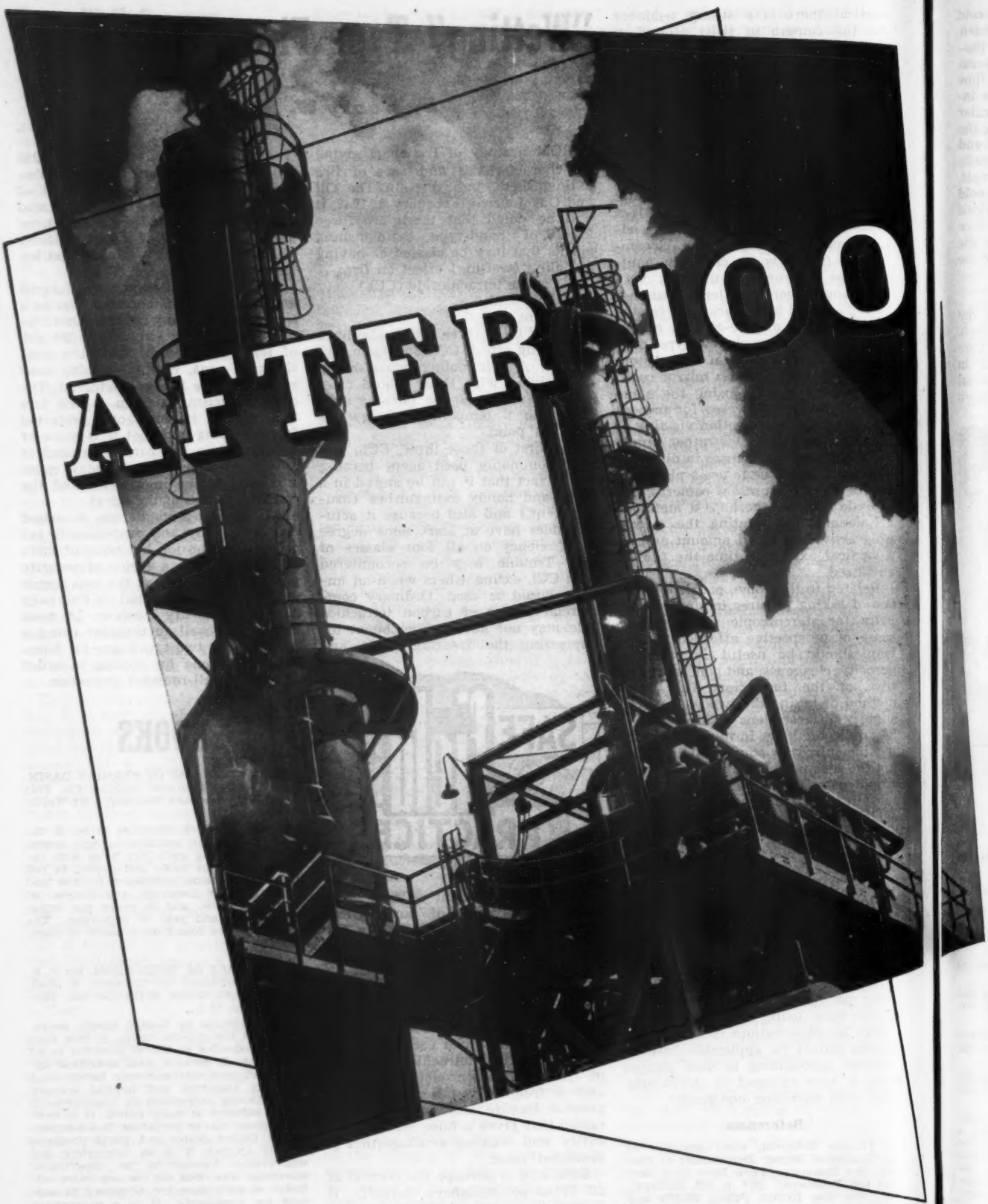
BOOKS

EXECUTIVES MAP OF PERMIAN BASIN. Published by Southwest Mapping Co., Fort Worth National Bank Building, Fort Worth. $7.50.

This map, which measures 48 by 36 in., shows in blue ink, sections, surveys, towns, oil wells, drilling wells, dry holes with operator and farm name and depth; in red the oil-field name, producing horizon and depth, year of discovery, and number of producing wells; and in green the larger lease blocks and year of expiration. The map should be found most useful in many ways.

ESSENTIALS OF PETROLEUM. By P. H. Frankel. Published by Chapman & Hall, Ltd., 37 Essex Street, W.C.2, London, England. 173 pp. 15 s.

In a foreword by Gustav Egloff, he reports that the general theme of this book is the economics of the oil business in all its phases. It gives a good analytical appraisal of pertinent economic factors in a generally impartial and neutral manner, while offering suggestions for improvements in the industry at many points. It is written without bias or prejudice. The contrasting of United States and world problems is ably treated. It is an interesting and well-written treatise by an experienced economist who does not use any more statistics or data than are necessary to support his viewpoints. It is a provocative book from many angles. It may well be helpful to the oil industry in indicating that whatever changes should take place should be made from within rather than from without.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QUESTIONS on TECHNOLOGY

by W. L. Nelson

Consulting Engineer

Oxygen Manufacture

Simplified Flow Diagram

We hear that oxygen is to be used rather than air in the Hydrocol and Stanolind plants for making gasoline from natural gas. How can oxygen be obtained cheaply enough for use this way?—F. A. C.

Newly described plants for making oxygen are not fundamentally different from the Linde and Claude methods used heretofore except that several ingenious mechanical and physical devices have been devised by which the cost of operation is greatly reduced. These improvements or innovations partially eliminate the (1) fouling of heat-exchanger surfaces, (2) freezing or plugging of lines with ice or carbon dioxide, (3) cost of chemical agents for the removal of carbon dioxide and water, and (4) excessive cost of operating reciprocating-type compressors. The advantages are accomplished mainly by the use of a "reversing" type exchanger, and by centrifugal compressors. Power for operating the compressors is obtained cheaply from the waste heat (steam) available in the Fischer-Tropsch process. Thus, the Fischer-Tropsch process and the manufacture of oxygen make a good combination by which waste or cheap power is employed to produce oxygen and in turn the oxygen facilitates the Fischer-Tropsch process. Recent articles on the manufacture of oxygen are listed as references at the end of this article.

The flow diagram as shown in Fig. 2 is not very satisfactory because the process involves two repeating cycles of flow through the reversing exchanger. This means that two different fluids pass through the same lines in a continuously repeating cycle, nor can two sets of flow lines be shown without introducing more confusion.

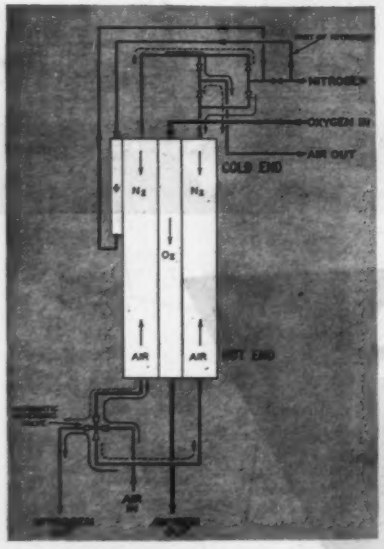

Fig. 1—Diagram of reversing exchanger (used in manufacture of oxygen)

Reversing Exchanger

Before attempting to explain the process, it is necessary to explain the performance or use of the so-called reversing exchanger. It consists (see Fig. 1) of three main passageways. Cold outgoing oxygen flow continuously through one of these. At any time warm incoming air flows through one of the other two passageways and in a direction countercurrent to the oxygen. Meanwhile, lower-pressure nitrogen flows through the passageway not being used for incoming air. At about 3-minute intervals the flow of air (and of nitrogen) must be switched to the other passageway because ice and carbon dioxide accumulate on the heat transfer surface. The nitrogen removes the ice and carbon dioxide because it is at a lower pressure (10 psig.) and thus its dew point is lower or its capacity to hold these impurities is greater than that of the air (85 psig.). In addition an unbalanced passageway encases the cold end of the exchanger and nitrogen flows continuously through this passage to control the outlet temperature of the air. The direction of flow during the two modes of flow is indicated on Fig. 1 by means of regular and of dotted lines. In controlling the flow, a reversing valve at the **hot end** of the exchanger is automatically turned at about 3-minute intervals. The check valve system at the **cold end** of the exchanger adjusts itself automatically to reversals of flow because of the low pressure of the nitrogen and the high-pressure of the air.

Oxygen Manufacture

In the flow diagram (Fig. 2) the reversing exchanger is not shown. Only one flow is shown and the true reversing flow can be followed in Fig. 1. The manufacture of technical grade oxygen (95 per cent) as shown

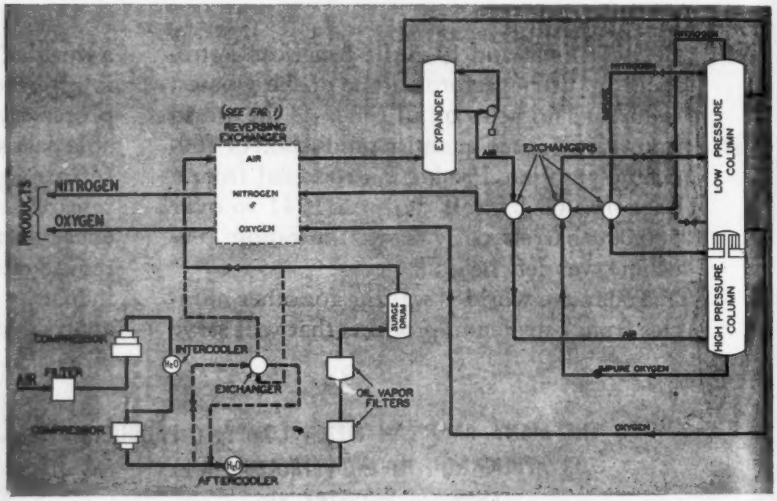

Fig. 2—Simplified flow diagram of oxygen manufacture

in Fig. 2 involves the following main operations:

1. Air is filtered to remove dust, etc.
2. Compressed to 30 psig. and intercooled to 100° F.
3. Second stage compression to 85 psig. and aftercooled from 300° to 100° F.
4. Filtered through activated carbon to remove traces of hydrocarbon vapor.
5. Cooled with outgoing cold oxygen and nitrogen by means of a reversing exchanger as shown in Fig. 1.
6. Ice and carbon dioxide are eliminated into the outgoing nitrogen by the reversing exchanger.
7. Air is further cooled (from expander vessel) by heat exchange with cold nitrogen in a fixed exchanger.
8. Air is partially fractionated in a high-pressure column (20 trays) to produce a 35 per cent oxygen bottom product. The impure oxygen (bottom) and the somewhat pure nitrogen (top of high-pressure column) are both cooled by heat exchange with nitrogen and sent to the low pressure (10 psig.-40 tray) column.
9. The low-pressure column is fed with the 35 per cent oxygen and it is refluxed with the impure nitrogen. The pure oxygen and nitrogen leave the low-pressure

column and pass from the plant through the reversing exchanger.

The expander cycle is used mainly for cooling of the plant during start-up. Auxiliary lines are provided by which air, nitrogen or oxygen can be expanded for refrigeration. The towers, lines and exchangers operate at very low temperatures (—250° to —310° F.) and hence they are heavily insulated and are constructed of such metals as aluminum, copper, and stainless steel. The cost of manufacture is stated in Reference 2 to range downward from about $6 per ton for a 100-ton-per-day plant, to nearly $2 per ton for a 1,600-ton-per-day plant. These costs are for a 15-year depreciation, all labor at $2 per hour, power at 5 mills per kw.-hr. and maintenance at 2 per cent of the capital investment.

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Combustion-of-Coke Deposit on Bead Catalyst

(Continued from page 80)

6-in. lining of insulation with a refractory surface adjacent to the flowing catalyst. All parts handling flue gas and air inside the kiln are of oxidation-resisting steel (4-6 per cent Cr., 1-2 per cent Si, 0.45-0.65 per cent Mo). The cooling tubes are usually 2⅜-in. o.d. on 4¼-in. centers. The kiln for a typical 10,000-bbl.-per-day T.C.C. unit is about 120 ft. in over-all height, has an internal cross-section area of 100 sq. ft., contains 10 burning zones and burns up to about 5,000 lb. per hour of carbon from catalyst circulating at a rate of about 100 tons per hour. Air feed rates range from 17,000 to 25,000 cu. ft. per minute and the quantity of steam generated varies from 18,000 to 40,000 lb. per hour. Typical operating data from such a kiln are presented in Table 2.

Acknowledgment

The authors are indebted to R. D. Drew, K. M. Manion, and F. E. Ray of Socony-Vacuum Laboratories for valuable help in obtaining and correlating the experimental data.

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Dates Set for Annual Penn-Grade Meeting

The annual meeting of the Pennsylvania Grade Crude Oil Association will be held June 5-6 at the William Penn Hotel, Pittsburgh. The dates were set by the board of directors at a recent meeting in Oil City, Pa.

The association's research work relating to investigation of field applicability of Dr. C. E. ZoBell's process for use of bacteria in oil recovery has won the "deep appreciation" of the American Petroleum Institute, the directors learned. A resolution to this effect received from the American Petroleum Institute was read. D. T. Ring, Columbus, Ohio, association president, voiced optimism regarding the production outlook of the Pennsylvania-Grade crude-oil region in 1947. He pointed out that each district in the region showed an uptrend in production last year over 1945.

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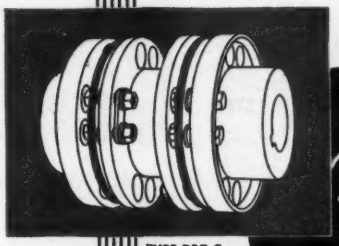

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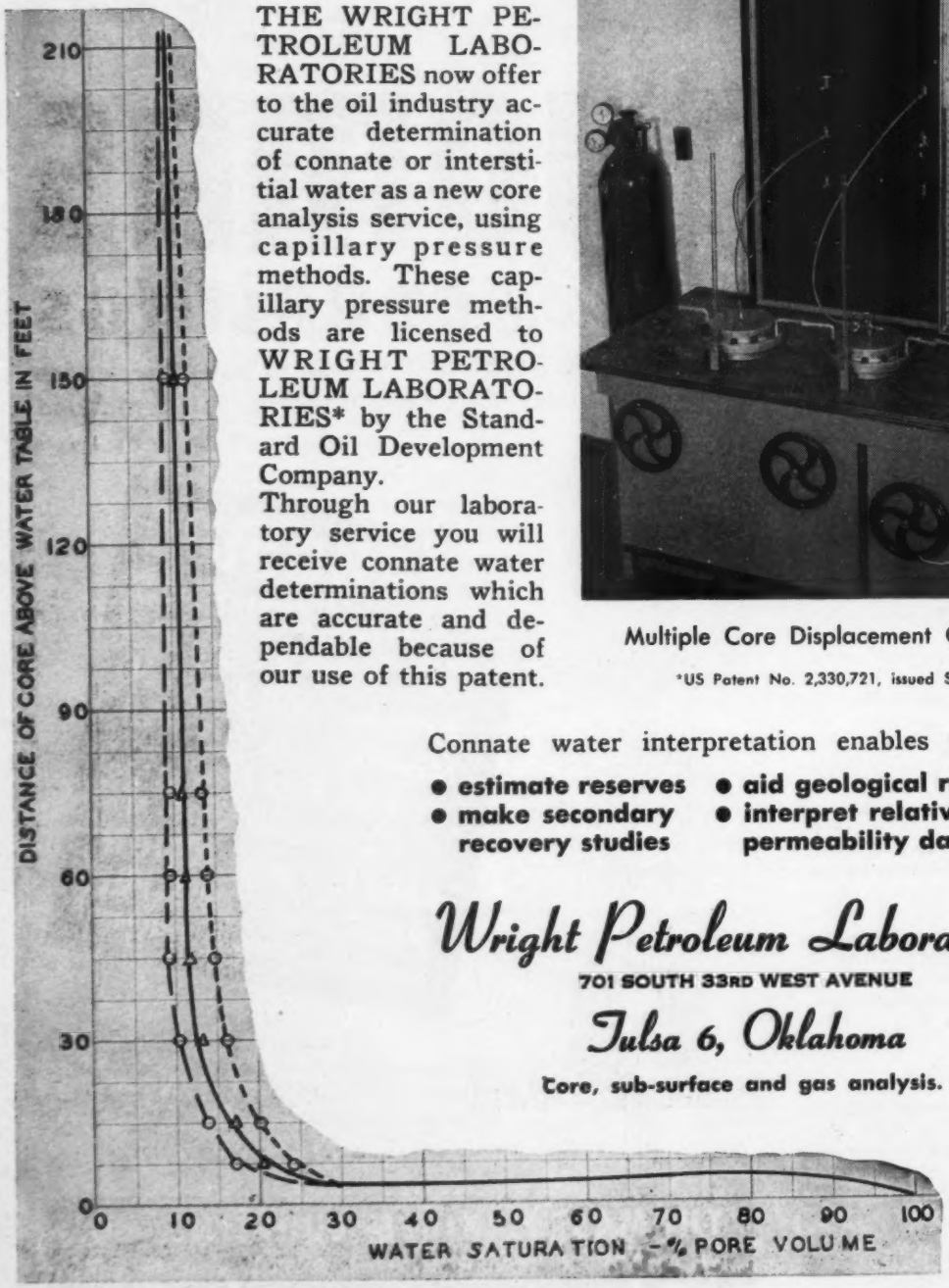

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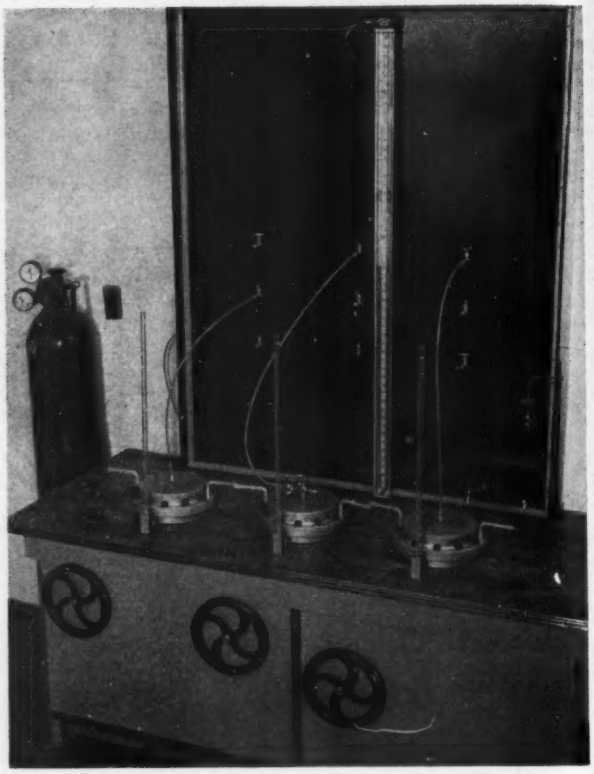

Multiple Core Displacement Cell Apparatus

*US Patent No. 2,330,721, issued Sept. 28, 1943.

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MODERN Rotary DRILLING

Portable Drilling Masts

ON deep wells the increasing use of "tall derricks" is the industry's contribution toward improving the efficiency of operations by reduction of time needed for round trips with bits. On shallow and medium-depth wells the growing application of portable drilling masts has as its purpose reduction of the over-all time needed for completion of the well, by reduction of time needed for erection and dismantling of the derrick. In the not too distant past, use of a portable drilling mast suggested extremely shallow drilling only. Now, drilling with this type of equipment to 7,000 or 8,000 ft. is quite common.

There are, as yet, no standard A.P.I. specifications for portable drilling masts. As a result, masts are built in a variety of sizes, types, and capacities. Different designers solved through different methods of construction the problems resulting from the fundamental requirements imposed on portable drilling masts. The requirements are: portability, strength and rigidity, speed of erection and dismantling, and safety. The manner in which the problems of these requirements have been solved in different designs is summarized in this and the following installments of the series.

Types and Capacities

Types of portable drilling masts are available from double-leg telescoping with height of 65 ft. to four-leg masts, 136 ft. in height. Nominal load-capacities range up to 720,000 lb. From the point of view of their application, masts may be had all the way from those designed for work-over and shallow or slim-hole drilling to those which are capable of performing the work of conventional drilling derricks for normal, medium-depth drilling operations. Some masts are built in series so that a mast of a given height may be converted into one of larger or lesser height by adding or removing certain portions of the mast. Varying height is attained in other designs simply by extending the upper, telescoping part of the mast.

As a general rule four-leg masts are built in an open-face type, i.e., with one side of the mast open, and are set in a slightly tilted position, with the pipe racked outside of the derrick. One of the manufacturers offers a mast with all the four faces laced in and with the pipe racked inside of the derrick. (See Fig. 10.)

The mast is provided on one side with an offset or bulge, which furnishes the space needed for pipe packing. The offset accommodates 108 thribbles of 4½-in. drill pipe. Since the pipe is racked inside the derrick, there is no need for the open face of mast. With positive support thus provided, there is no need for the usual interior bracing. In process of design is a 136-ft. mast of the same type, with two bulges, one on each of the two opposite sides of the mast. The combined capacity of the two offsets is more than sufficient for pipe-racking requirements of the drilling depth for which the mast is designed.

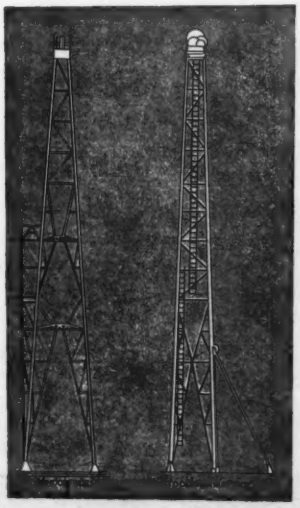

Fig. 10—Portable sectional drilling mast with all four walls laced in and with an offset for racking of pipe

Portability

From the point of view of the manner in which the question of portability is solved, the drilling masts may be divided into two groups. To the first group belong the masts which are truck or trailer mounted and are of the telescoping type. That means they are raised to their partial height by any of the several available methods, to be discussed later, and are then extended to their full height. To the second group belong sectional masts. They are built in sections which are assembled horizontally on the ground. The mast is then raised as a fully completed unit. Number of sections into which the mast is dismantled and number of truckloads needed for moving, depend on the size of the mast. The heaviest mast of this type now available requires three truck loads, not including the substructure. Where local conditions permit, and for short hauls, these masts sometimes may be moved in one piece.

The crown block assembly usually is made an integral part of the top section of the mast. In majority of cases the mast may be moved with crown and traveling blocks strung up, with traveling block pulled up into the top section of the mast.

Strength and Rigidity

In the design of masts, A.P.I. formulas for calculations of conventional derricks are strictly adhered to whenever they are applicable. For instance, in majority of cases the masts are designed to withstand a 70-mile wind with a full setback of pipe. In some cases, calculations assume that the mast is guyed.

The masts are built of seamless tubular members and structural shapes. Different types of alloy steels are used. Bracing and welded construction lend rigidity to the structure.

No. 11 in a series by Joseph Zaba, petroleum engineer, Houston

BEARINGS

You can't go wrong when you get your bearings from the $23,000,000 stock now being sold by WAA. Friction and anti-friction bearings and components—all sizes and types—all unused and in top condition. Set your own price on what you need. Your nearest WAA Regional Office will give you all pertinent information on the sale and will assist you to make an inspection before submitting your bid.

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1021

The Refiner's Notebook

A WEEKLY FEATURE OF THE OIL AND GAS JOURNAL

Theoretical Stack Draft

TABLE 1 of static draft shown on this page is the customary theoretical information found throughout the literature and text books. It is based on a height of 100 ft. The draft for other heights is directly proportional to the height of the stack. It is misleading in several respects because corrections should be applied for such factors as:

1. It is based on a sea-level elevation. A correction for altitude is necessary.

2. The average temperature of the flue gases is seldom known. To compute the loss in temperature of the flue gases is difficult because of the effect of wind and rain as well as the velocity at which the gases pass through the stack.

3. It is assumed that the column of gases in the stack is static, that is, no movement is occurring. The correction for friction loss is small except in very small-diameter stacks which operate at high flue gas velocities (approximately 30 ft. per second and higher). For such extreme conditions the friction loss may be computed from:

$$h = \frac{f L u^2}{D T}$$

in which:

h = draft loss, in. water
L = height, ft.
D = diameter, ft.
u = velocity, ft./sec.
T = absolute temp., °F. plus 460
f = factor, masonry 0.008, steel 0.0075

Stack draft is directly proportional to the barometric pressure and hence the effect of altitude is:

Altitude (ft.)	Barometer in. Hg.	Multiplier for draft
0	29.9	1.000
1,000	28.8	.963
2,000	27.8	.930
3,000	26.8	.896
4,000	25.9	.865
5,000	25.0	.836
6,000	24.2	.808
8,000	22.5	.752

Charts of stack draft corrected for cooling of the stack gases will be published in Refiner's Notebook Nos. 137 and 139 of March 29, and April 12, 1947.

TABLE 1—STATIC STACK DRAFT

Avg.temp. of gases in stack (°F.)	Available static draft, inches water in a 100-ft. stack at sea level. Atmospheric temperature, °F. (quiet air—no rain)										
	0	10	20	30	40	50	60	70	80	90	100
250	.53	.50	.47	.44	.41	.38	.34	.32	.29	.27	.25
275	.57	.53	.50	.47	.44	.41	.38	.36	.33	.31	.28
300	.61	.57	.54	.51	.48	.45	.42	.40	.36	.34	.32
325	.64	.60	.57	.54	.51	.48	.45	.42	.39	.37	.35
350	.67	.63	.60	.57	.54	.51	.48	.50	.43	.41	.38
375	.70	.66	.63	.60	.57	.54	.51	.49	.46	.44	.41
400	.73	.69	.66	.63	.60	.57	.54	.52	.49	.46	.43
425	.76	.72	.69	.66	.62	.59	.57	.54	.51	.49	.46
450	.78	.74	.71	.68	.65	.62	.59	.57	.54	.50	.48
475	.80	.77	.74	.71	.67	.64	.61	.59	.56	.54	.51
500		.79	.76	.73	.69	.66	.63	.61	.58	.56	.53
525			.78	.75	.72	.69	.65	.63	.60	.58	.55
550			.80	.77	.74	.71	.67	.65	.62	.60	.57
575				.79	.75	.72	.69	.67	.64	.62	.59
600				.81	.77	.74	.71	.68	.65	.63	.60
625					.79	.76	.73	.70	.67	.65	.62
650					.80	.77	.74	.71	.68	.66	.63
675						.79	.76	.73	.70	.68	.65
700						.80	.77	.75	.72	.69	.66
725							.79	.76	.73	.71	.68
750							.80	.78	.75	.72	.69

No. 135 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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ENGINEERING *fundamentals*

Well-Service Units

IN order to save time and expense, several oil companies make wide use of motorized equipment for well-servicing operations and maintain trucks at district headquarters, fully equipped for almost any contingency that might arise.

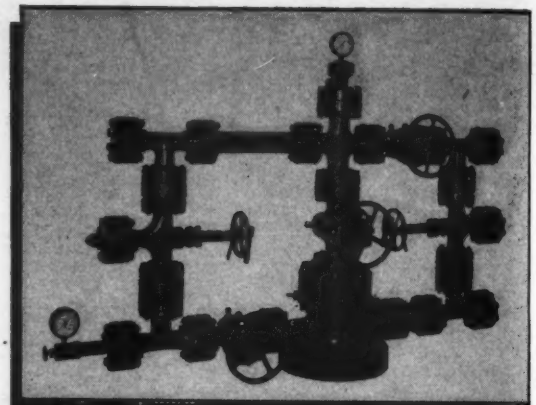
The following is a complete list of the equipment which one company has found highly satisfactory.

1—Well-servicing unit mounted on a heavy-duty truck with 8 by 10-in. by 58 ft. telescoping pipe mast.
1—Tubing spider with slips and guide rings for 2, 2½, and 3-in. tubing.
1—Tubing block complete with bails, swivel, and top bicket.
1—3-in. U.S.E. tubing elevator.
1—3-in. regular tubing elevator.
1—2½-in. U.S.E. tubing elevator.
1—2½-in. regular tubing elevator.
1—2-in. U.S.E. tubing elevator.
1—2-in. regular tubing elevator.
2—3-in. tubing tongs.
2—2½-in. tubing tongs.
2—2-in. tubing tongs.
1—Medium-size chain tong.
1—Portable tubing rack (on unit).
1—Portable tubing rack (available at headquarters).
1—¾-in. by 300-ft. nonrotating tubing line with Ratigan ends (thimbles).
2—Stringing-up links (tubing line).
2—36-in. wrenches.
2—24-in. wrenches.
2—18-in. wrenches.
1—8-in. snatch block.
1—1-in. by 20-ft. hose (for filling tubing).
1—Two-stage tubing pressure pump with connections for 2, 2½ and 3-in. tubing, upset and regular, V-thread and round thread.
3—⅜-in. by 20-ft. electric-weld guy-line chains.
3—Heavy-duty "come along" boomers with 7-ft. tail chains.
2—⅜-in. by 15-ft. electric-weld log chains (tie tubing) (pick up work) (snatch block).
2—½-in. by 15-ft. electric-weld chains with hooks (for tie down on derricks).
1—1-in. by 120-ft. derrick rope (for mast).
1—Oil-well measuring device with float and weight.
1—Rod hook.
1—Rod-line weight.
2—Rod elevators for 1-in. and ⅞-in. rods.
2—Rod elevators for ⅞-in. and ¾-in. rods.
2—Rod elevators for ¾-in. and ⅝-in. rods.
2—Rod wrenches for 1-in. rods.
2—Rod wrenches for ⅞-in. and ¾-in. rods.
2—Rod wrenches for ⅝-in. rods.
1—Rod wrench for 1-in. rod boxes.
1—Rod wrench for ⅞-in. rod boxes.
1—Rod wrench for ¾-in. rod boxes.
1—Rod wrench for ⅝-in. rod boxes.
1—Universal size cage wrench.
2—Thread chasers for 1-in. and ⅞-in. rod box and pins.
2—Thread chasers for ¾-in. and ⅝-in. rod box and pins.
1—Running nipple for 3-in. pumping tee.
1—Running nipple for 2½-in. pumping tee.
1—Running nipple for 2-in. pumping tee.
1—Rod paraffin stripper with adaptors for 3, 2½ and 2-in. pumping tees.
1—Circle rod wrench (safety wheel).
1—3 in. by 2-ft. pickup nipple with combination collars for regular and U.S.E. 10V thread, 8 round thread, 10 round thread, and 11½ V thread.
1—2½-in. by 2-ft. pickup nipple with couplings to fit threads as above.
1—2-in. by 2-ft. nipple with couplings as above.
1—½-in. by 20-ft. wire line (hang wells off and on).
1—10-ton hydraulic jack.
1—Water cooler adequate for crew.
1—First-aid kit adequate for crew.
3—3-in. by 12-in. by 30-ft. hardwood T sills for mast footing.
1—Set ⅜ to 1½-in. open-end and box-end wrench set.
1—Large screw driver.
1—Small screw driver.
1—Pair large pliers.
1—Pair small pliers.
1—Large cold chisel.
1—Small cold chisel.
1—Large punch.
1—Small punch.
2—Large ball pein hammers.
1—Small ball pein hammer.
1—Large diamond point.
1—Small diamond point.
1—Rig-builders hatchet.
1—¼-in. steel numeral stencil (1 to 10).
1—½-in. numeral stencil (1 to 10).
1—15-in. adjustable wrench.
1—10-in. adjustable wrench.
1— 6-in. adjustable wrench.
1—15-in. mill flat file.
1—10-in. mill flat file.
1—12-in. mill half-round file.
1—12-in. rat-tail file.
1— 8-in. rat-tail file.
1—Three-cornered saw file.
1—Hack saw.
1—Hand saw.
2—Wire-thread brushes.
2—Medium-size paint brushes (cleaning).
2—Thread files for thread end and collar end, 10 V, 8 round, 10 round, 11½ V threads.
1—50-ft. steel tape.
1—5-ft. crow bar.
1—30-in. pinch bar.
1—Nail bar.
1—Spear for operating lead-line gates.
1—Force-feed grease gun.
1—Force-feed oil can.
1—Supply container for grease.
1—Supply container for oil.
1—Supply container for thread compound.
1—Set mud chains for truck.
1—Set trouble flares (regulation).
1—3-in. rod socket for 1, ⅞ and ¾-in. rods.
1—3-in. rod socket for 1 in., ⅞ in. rod boxes and pins.
1—2½-in. rod socket for 1, ⅞, ¾, and ⅝-in. rods.
1—2½-in. rod socket for ⅞, ¾ and ⅝-in. boxes and pins.
1—2-in. rod socket for ¾ and ⅝-in. rods.
1—2-in. rod socket for ¾ and ⅝-in. rod boxes and pins.
1—½ to 1½-in. tapered tap to fish pump holddowns.
1—Retrievable drop valve for 3, 2½, and 2-in. tubing.
1—2½-in. rod socket for 1½ and 1¼-in. polished rods.
1—2-in. rod socket for 1¼, 1⅛ and 1-in. polished rods.
20—Ft. ⅞-in. pony rods (8, 6, 4, and 2 ft.).
20—Ft. 1-in. pony rods (8, 6, 4, and 2 ft.).
20—Ft. ¾-in. pony rods (8, 6, 4, and 2 ft.).
12—Ft. ⅝-in. pony rods (8, 6, 4, and 2 ft.).
1—Round-point shovel—long handle.
1—Square-point shovel—short handle.
1—Sharp-shooter spade.
1—Heavy broom.
1—Scuffle hoe.
3—Extension handles for tongs, pipe wrenches (1½-in. barrel tube).
1—16-lb. sledge hammer.
1—Salt-tablet dispenser and tablets.
1—Drinking-cup holder and cups.
1—Waste basket for cups, papers, rags, etc.
1—Trouble light (lantern or cord).
4—Pipe tube to carry pumps, pony rods. Hooks, brackets, shelves, and boxes to carry tools and equipment.
1—Portable rod rack (on unit).
1—Portable rod rack (available at headquarters).

The above equipment plus a good supply of replacement parts, pumps, cups, bails and seats, collars (all combinations and plain), rod boxes (all combinations and plain), stuffing-box rubbers (kinds and sizes), dresser rubbers, packing, roller grip rubbers, union bolts.

Series prepared by Dr. E. A. Stephenson, head of petroleum engineering school, University of Kansas

PROBLEM *Shop testing* Christmas Trees, valves and high pressure fittings.



PROBLEM *Shop testing* separators, tanks and other pressure vessels.

PROBLEM *Shop or field testing* tubing, casing and other tubular goods.

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McFarland Units may also be used for operating blowout preventers, for high pressure washdown, cleaning and paint spraying; for operating hydraulic presses and other services requiring compression and discharge of liquids. Detailed information gladly furnished upon request.

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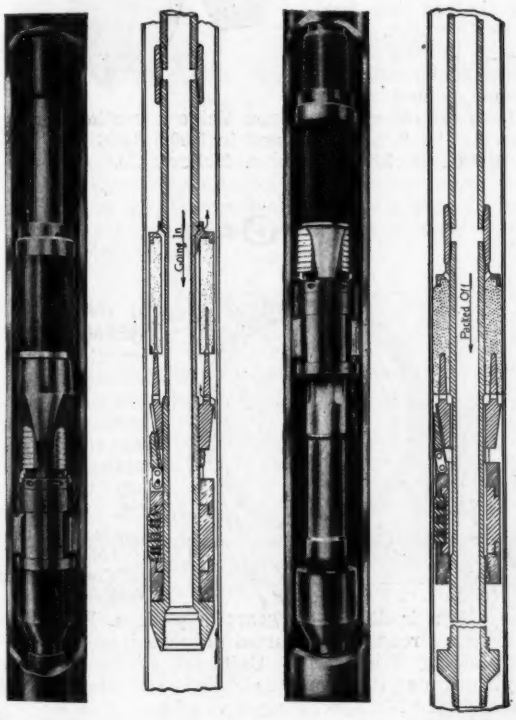
1630 Roberts Street — HOUSTON, TEXAS — Phone Fax. 7165

OIL AND GAS EQUIPMENT Digest

IT'S NEW ✓ CHECK IT

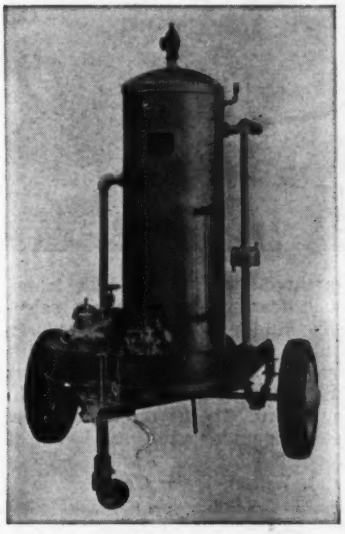
by John M. Spears

(1) NEW HOOK WALL PACKER is short, light weight, strong, and simple in design. In this "positive seal" packer, three friction blocks, hard faced with stellite, are used in place of friction-wiper springs. Blocks are



held against wall of casing by three coil springs, and insure correct setting at any depth. A coarse flat-type thread is used to lock slip carrier in place. To set packer, tubing must be turned 2½ revolutions—a feature which eliminates accidental setting and resultant damage to packer. Nonvulcanizing packoff element is expanded by conical wedge, and the split design of packoff gives a "lip-seal." Ample "bypass" area for fluid between tube and packoff is provided. *Wilson Foundry & Machine Co.*

IT'S NEW ✓ CHECK IT



(2) PORTABLE WELL-CHECK UNIT is used to determine crude - production quantity and quality, gas-oil ratios, and b.s. and w. of oil wells. Twenty-four-hour capacities range from 175 bbl. of oil and 325 M.c.f. of gas at 25-lb. pressure to 500 bbl. of oil and 1,000 M.c.f. of gas at 100-lb. pressure. Unit consists of special oil-well Xacto meter; automatic proportional sampler; spill-proof gas trap with peel-off valve; manifold for returning fluid and gas to the production line during testing period; and a sturdy chassis with trailer hitch and adjustable swivel caster. *Bowser, Inc.*

IT'S NEW ✓ CHECK IT

(3) MOBILE ROTARY UNIT for faster and cheaper drilling of shallow wells, drills an 8-in. hole to a depth of 1,000 ft. and a smaller hole to a depth of 1,500 ft. All equipment is truck mounted in unitized subassemblies which can be replaced easily on location. Simplified control design, a hydraulically operated "pull down" for weight control on the bit and for lifting pipe, a new design for slips and break-out tongs, and utilization of standard Ford-truck drives, differentials, and universal

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

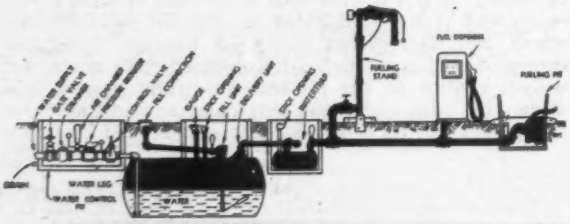
Keep Informed. Save Time. Tear Out Card. Check It. Mail It.

joints (Spicer) are the more important innovations. Power for the rotary turntable, draw works, and slush pump is supplied by truck motor, using a split-shaft-type power takeoff from drive shaft. It is constructed of Brown-Lipe transmission parts with a triple chain- and sprocket drive. Turntable is shaft driven from

power takeoff through a three-speed Brown-Lipe transmission which, with truck transmission, gives a selection of 12 drilling speeds. Mud pump and draw works are driven with one double shaft with a sprocket-and-chain drive from the power shaft. Illustration shows turntable with slips and new-type breakout tong in position for breaking out joint. Chains on either side, operating over sprockets on under side are part of hydraulic pipe "pull down." They are turned by hydraulic motor (lower left). *Winter-Weiss Co.*

IT'S NEW CHECK IT

(4) HYDRAULIC FLOTATON SYSTEM for storage and delivery of liquids which are immiscible with water, is based on fact that certain fluids, such as gasoline, are lighter than, and will not mix with water. Fuel in storage tank floats on water and is delivered merely by starting a controlled flow of water into bottom of the tank. Fuel

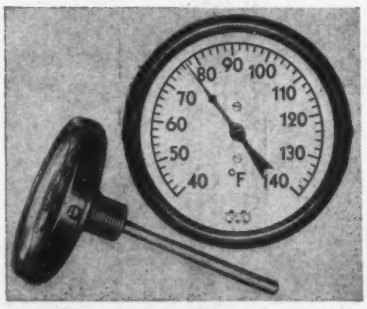


entering the tank at the top forces water out from bottom. When tank is nearly full, the fill unit (a float-operated valve) automatically shuts off flow, and prevents escape of any fuel into water drains. Fuel leaving storage tank passes through delivery unit, which is operated by a metal float too heavy to float in fuel but light enough to float in water. This unit automatically closes delivery line when water nears top of the emptying storage tank, thus preventing entry of water into delivery line. *Petroleum Systems, Inc.*

IT'S NEW CHECK IT

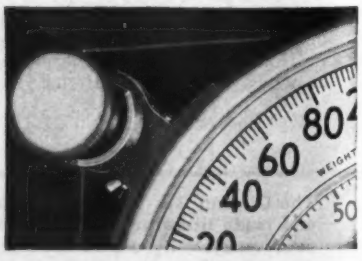
(5) NEW CONDUIT GATE VALVE for high-pressure oil-field service on distillate wells and high-temperature corrosive wells, features an automatic lubrication system that continuously protects valve from leaks. System is arranged so lubricant is automatically injected from a reservoir to sealing area whenever it is needed. Nondistorting seats, gate halves that automatically align themselves to the undistorted seats, and hard chrome-plated sealing surfaces are other innovations. Valve is available in four sizes: 2, 2½, 3, and 4-in. and in 5,000, 3,000, and 2,000-lb. W.O.G. working pressures. *McEvoy Co.*

IT'S NEW CHECK IT



(6) NEW DIAL THERMOMETERS accurately indicate liquid or gas temperatures. Compact durable instrument has stainless-steel bulb and stem with rolled-end cap. No solder is in contact with fluid being measured for temperature. Action is direct—no gears or pinions. For correct temperature reading bulb need only be immersed 2 in. in liquid and 4 in. in gas. Units are available in temperature range from minus 40° F. to plus 500° F. *Marshalltown Manufacturing Co.*

IT'S NEW CHECK IT

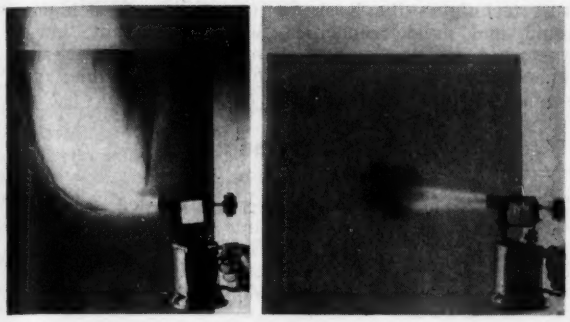


(7) ADJUSTABLE INSTRUMENT LAMP of vapor-proof and moisture-proof construction is used on drilling-control instruments. Extremely rugged and easily adjusted fixture provides maximum oil-field usefulness and service. Made of die-cast aluminum with Pyrex-glass tubing and 15-watt lamp set in a cork gasket, it is equipped with 20 ft. of 3-cable cord and cord cap. Lamp is compact. Flexible rubber bracket

is provided for mounting fixture on a gage ring or panel. *Martin-Decker Corp.*

IT'S NEW CHECK IT

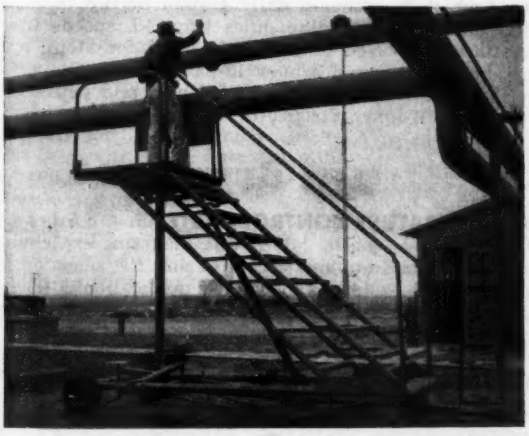
(8) ALBI-R is a simple and effective way to combat loss of life and property caused by fire. Chemical is a fire-retardant coating material applied like paint to combustible surfaces. When flame is applied to their



coated surface, it breaks out into a rash of small and large blisters that puff out to form a heavy insulation mat of incombustible insulation between the flame and surface underneath. In addition to resisting the destructive forces of fire, it effectively retards spread of flame. Also serves functions of decoration and maintenance. *Albi Chemical Co., Inc.*

IT'S NEW CHECK IT

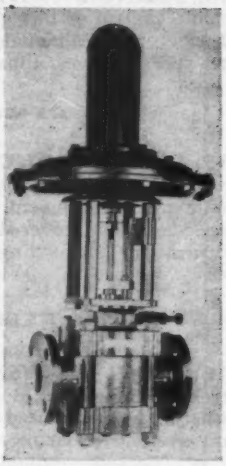
(9) AEROSTANDS for painting, inspection, and maintenance of refineries, natural-gasoline plants, etc., are made of welded tubular steel with manually operated hydraulic pumps for fast positioning. Stands are easily



moved on large balloon tires by one man. Platform-height adjustment ranges from 3 to 24 ft. and self-adjusting steps maintain their position parallel to ground regardless of angle of stand. Included in optional equipment is hoist attachment for lifting weights up to 1,000 lb. *Aeroquipment Co.*

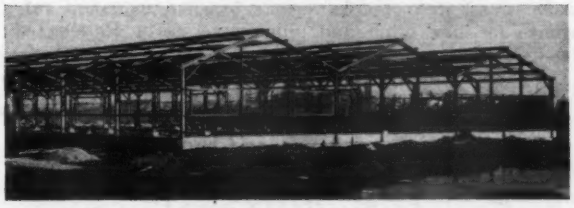
IT'S NEW CHECK IT

(10) VALVRATOR MOTOR VALVE is a new-design automatic flow-control valve operated by a diaphragm air motor. Dished-bonnet construction with flush-seated bodies and through bolts results in a compact light-weight unit, simple cleanout characteristics, and fabrication in many corrosion-resisting materials. Valve port is of the double-seated type, built as a single lantern-like piece press fitted into the body. Plugs are machined as cones with constant taper, but taper of the two cones may vary according to flow characteristics. Diaphragm air motor is attached to valve bonnet by either two or four steel-bar stock posts. *Fischer & Porter Co.*



IT'S NEW CHECK IT

(11) STANDARD BUILDINGS for many refinery, warehouse, and oil-field uses, are production-line constructed in widths from 40 to 100 ft. with lengths adjustable in 20-ft. increments, inside clearance at eaves from 12 to 20 ft. Fabricated of heavy structural steel for permanence, frame work may be covered with corrugated-steel siding



and roofing or various types of collateral materials. Skillful engineering of unit system of expansion in both width and length permits assembly in unlimited variations of size and arrangement. Selection from numerous standard alternates allows for location of doors and sash of individual choice. These flexible features meet most industrial requirements and eliminate expense of special engineering with the gain of production-line economy. *Luria Engineering Corp.*

IT'S NEW CHECK IT

TRADE LITERATURE

(12) LIGHT HYDROCARBON PROPERTIES. New handbook presents, in tabular form, hydrocarbon and light petroleum liquid and gas properties, with thermal data and data on combustion. Blank columns are provided for insertion of additional data as they are developed. *Griffin Chemical Co.*

IT'S NEW CHECK IT

(13) SUCTION HOSE. New six-page printed folder covers construction and application of rotary-drilling and mud-pump suction hose. Available for three depths—

heavy-duty deep-well work, medium depth, and slim-hole drilling and well workover. *Hewitt Rubber Division, Hewitt-Robins, Inc.*

IT'S NEW ✓ CHECK IT

(14) SOLENOID VALVES. Valves for the automatic and remote control of flow of liquids and gases presented in 12-page circular. Includes shutoff, pilot, explosion-proof, and special valves. Illustrated. *Automatic Switch Co.*

IT'S NEW ✓ CHECK IT

(15) ENGINE-PROTECTION EQUIPMENT. Safety controls, alarm systems, special-indicator systems, and automatic plant equipment for internal-combustion engines are completely covered in a 2-color, 30-page catalog. Illustrations and ratings included. *Viking Instruments, Inc.*

IT'S NEW ✓ CHECK IT

(16) NICKEL ALLOYS. Corrosion-resistant high-strength nickel and Monel alloys are treated in 12-page bulletin. Individualized characteristics and applications, and average mechanical properties are given for each alloy. *The International Nickel Co.*

IT'S NEW ✓ CHECK IT

(17) PLUG VALVES AND LINE BLINDS. New 50-page 1947 general catalog covers manufacturer's complete line of line blinds and plug valves. Includes general description, dimensions, illustrations, installation and operating instructions, and complete price list. An excellent reference for line blind and plug valve users. *Hamer Oil Tool Co.*

IT'S NEW ✓ CHECK IT

(18) STEAM AND LIQUID CONTROL EQUIPMENT. New 48-page catalog covers precision pressure-regulating, relief, and float valves; temperature regulators; self-cleaning strainers; water gages; gage cocks; illuminators; steam traps; air separators, etc. Includes dimensions, application, capacity, list price, engineering tables and specifications, and complete list of local sales engineering offices. *O. C. Keckley Co.*

IT'S NEW ✓ CHECK IT

(19) CHEMICAL PUMPS. A 10-page, 2-color bulletin is well illustrated with exploded views and cross-sectional drawings, and contains both performance and dimensional tables. Pumps described are designed to handle many liquids in a wide range of capacities. All parts such as castings and impeller parts which come in contact with the liquid being pumped are constructed of Ircamet, a corrosive-resistant alloy. *Ingersoll-Rand Co.*

IT'S NEW ✓ CHECK IT

(20) SIMPLEX UTIL-A-TOOL. "Jack of all trades"—pulls, pushes, spreads, bends, clamps, lifts; pulls pinions, bushings, and plain or spoked wheels and gears. This tool of many uses is pictured in many operations and completely described in new bulletin. *Templeton, Kenly Co.*

IT'S NEW ✓ CHECK IT

(21) FRACTIONATING TRAY. Vivid four-color pictorial brochure presents a late development in fractionating technique—the Kaskade tray, which gives higher liquid and vapor capacities, less entrainment, lower pressure drops, and high efficiencies. Design details and experimental and plant data included in a table, two graphs, and four figures. *Koch Engineering Co.*

IT'S NEW ✓ CHECK IT

(22) FLEXIBLE JOINTS. A 12-page catalog describes and illustrates flexible ball joints for oil, steam, air, gasoline, tar, water, gases, and liquids where a flexible conveyor is required. Dimensions and diagrams included. Also treats automatic panel fitter. *Moran Flexible Joint Co.*

IT'S NEW ✓ CHECK IT

(23) ALNOR PYROMETERS. New 16-page bulletin describes in detail pyrometers for measurement of diesel-engine exhaust temperature and for oil-field and refinery use on air preheaters, oil-quenching tanks, condensers, feed-water heaters, etc. Various types of single-circuit and multi-circuit design are illustrated with photographs and dimensional diagrams. *Illinois Testing Laboratories, Inc.*

IT'S NEW ✓ CHECK IT

(24) SANGAMO TACHOGRAPH. A recording speedometer which furnishes a daily graphic record of a vehicle's operation, including miles traveled, speeds traveled, time and place of stops, time out for stops, and other data are covered in new 12-page color bulletin. Of special interest to oil-field truck owners and petroleum distributors. *Wagner Electric Corp.*

IT'S NEW ✓ CHECK IT

(25) TEMPERATURE CONTROL SYSTEMS. Condensed bulletin presents charts, tables, and diagrams explaining measurement and automatic control and the selection of proper control systems for process applications. "Thermocouples, Their Placement and Hints Governing Their Use" and "Selection of Thermocouple Protecting Tubes" are treated separately. A.S.M.E. terminology to processes and automatic control is also listed. *Wheelco Instruments Co.*

IT'S NEW ✓ CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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REFINING

Rock Island Refining Corp. Buys Onyx Texas Plant

The 3,500-bbl. skimming and cracking plant of Onyx Refining Co., at Hawley, Tex., its headquarters, bulk distribution system, and approximately 80 miles of gathering pipe lines have been sold to Rock Island Refining Corp., Indianapolis; L. B. Simmons, Duncan, Okla., and L. E. Winkler, Indianapolis.

Consideration was not announced. O. B. Stephens, vice president and general manager under the former ownership, will remain in charge of operations, as well as other personnel of the plant, it was said. The plant, located 9 miles north of Abilene, receives crude from Taylor and Jones counties, West Central Texas.

Simmons was chairman of the board of Rock Island Refining Co. which last September sold its 8,000-bbl. plant at Beckett, near Duncan, to Wood River Oil & Refining Co., Wichita, Kans. Winkler is president of Rock Island Refining Corp. which operates a 6,000-bbl. daily refinery at Indianapolis.

Hovey Petroleum Will Build Houston Plant

A $200,000 paraffin-wax and asphalt plant will be built in the Houston area by Hovey Petroleum Co., company officials have announced.

Construction is scheduled to get under way within the next 3 months and be completed within the following 3 months.

Hearings Set on Change In A.S.M.E. Boiler Code

The boiler-code committee of the American Society of Mechanical Engineers has announced dates for two public hearings to be held on the proposed revision of Section VIII of the A.S.M.E. boiler-construction code (unfired-pressure-vessel code). The special committee for this revision submitted its draft in January.

The first hearing will be held May 1-2, at Rice Hotel in Houston. Sponsor will be the A.S.M.E. South Texas section. The second hearing will be at the Biltmore Hotel in Los Angeles May 7, with the Southern California section sponsoring.

Members of the boiler-code committee with its subcommittees expect to travel in a group to attend the hearings and to remain for their May meeting at the Biltmore Hotel, Los Angeles, May 9.

The purpose of the hearings is to provide an opportunity for comment and discussion of the proposed revision. The boiler-code committee is anxious to attract pressure-vessel manufacturers and users, state officials, representatives from the petroleum industry, enforcement authorities and any others interested.

1946 Rubber Use Well Above Previous Records

NEW YORK.—Rubber consumption in the United States totaled more than 1,034,000 tons during 1946 to break all previous records. Manufacturers used 799,099 tons in 1945 and only 648,500 tons in 1940, the previous record for a full, peacetime year.

A breakdown of the totals by the Rubber Manufacturers Association showed that the industry used 277,562 tons of natural rubber, 626,960 tons of GR-S, 44,420 tons of neoprene, 79,224 tons of butyl, and 6,024 tons of GR-A (N-type). In addition, manufacturers consumed 275,497 tons of reclaimed rubber.

Total value of the consumed rubber, calculated at 1946 prices, exceeds $500,000,000.

Technical Reports Index Being Issued by OTS

A comprehensive index guide to the thousands of reports on wartime technological developments in the United States, Germany, and other countries, now is being issued by the Office of Technical Services of the Department of Commerce. The index is intended for use with the weekly Bibliography of Scientific and Industrial Reports, published by OTS.

Mid-Continent Bright-Stock Production Little Changed

Bright-stock production of 12 Mid-Continent refineries showed little change in January, although a marked drop was noted in production of viscous neutrals.

The Western Petroleum Refiners Association, in its monthly compilation of the lubricating-oil statistics, reported bright-stock production of 236,652 bbl. in January as compared to 236,647 bbl. in December. Vis-

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cous-neutral production in January was 322,711 bbl. against 376,188 bbl. in December, a decline of 53,477 bbl.

January bright-stock and viscous-neutral shipments were 221,146 bbl. and 360,983 bbl. respectively, including 2,371 bbl. and 822 bbl. for export. Shipments in December totaled 215,736 bbl., including 3,905 bbl., for export; and 346,612 bbl., including 2,781 bbl. for viscous neutrals. Days' supply on hand in inventories January 31 were 25 for bright stock and 20 for viscous neutrals, compared with 23 days' supply for each grade December 31.

Bureau of Mines Compiles Data on Sulfur Properties

As a part of a research program to assist refiners in utilizing high-sulfur crudes, the Bureau of Mines has compiled information on the physical properties of several sulfur compounds likely to be found in petroleum.

Based on cooperative work between the bureau and the University of Wyoming, a new publication now available for free distribution to the industry lists the boiling points, freezing points, densities, and refractive indices of more than 300 sulfur compounds, according to Dr. R. R. Sayers, bureau director. Although the bureau is conducting related work on the identification of sulfur compounds in petroleum, the material was compiled in table form from available literature by William E. Haines, Welton J. Wenger, and R. Vernon Helm, petroleum chemists, and John S. Ball, refinery engineer, all of the bureau's petroleum and oil-shale experiment station at Laramie, Wyo. One of the major objectives of the bureau's research is the development of analytical methods whereby the different types of sulfur compounds present in petroleum may be identified and determined quantitatively. This is of prime importance in devising methods for the removal of undesirable sulfur compounds, many of which exhibit different effects on the properties of petroleum products, Sayers said. Describing some of the forms of these materials, the bureau report also discusses the nomenclature of sulfur compounds in petroleum.

Dividends of Refining Companies Show Gain

Publicly reported cash dividends paid during 1946 by refining companies totaled $363,600,000, against $322,900,000 during 1945, according to figures compiled by the Department of Commerce.

Dividend payments in December totaled $124,600,000, compared with payments of $101,800,000 in the same month of 1945, the department said.

New York Central Now Receiving New Diesels

Delivery of the last of 66 new diesel-electric locomotives, ordered from three builders by the New York Central System, is expected in May, according to officials of the railroad.

First of the 66, to cost in aggregate more than $11,000,000, were delivered late in February.

Of the group ordered, 20 are to be of 2,000 hp. each for use in passenger service; 34 of 1,500 hp. for freight service, and the remaining 12, also of 1,500 hp., for either freight or passenger service.

In Los Angeles, William M. Jeffers, chairman of the Citizens' smog committee, announced that Southern Pacific, Santa Fe, and Union Pacific officials have plans to increase the number of diesel engines operating in the area as an aid in reducing smoke.

Rubber Plant Visited

BATON ROUGE, La.—A group of executives of the nation's rubber industry, together with officials of Standard Oil Co. of New Jersey, headed by President M. J. Rathbone, recently toured the butyl-rubber plant at Standard's Louisiana division refinery in Baton Rouge.

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PIPE LINES

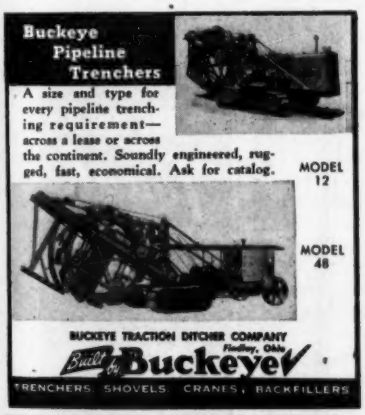
Arkansas Fuel Prepares For Plantation Terminals

Arkansas Fuel Oil Co. (Cities Service) has contracted with Latex Construction Co. for building terminals along the Plantation Pipe Line Co. system at Meridian, Miss., Birmingham, Ala., Knoxville, Tenn., Spartanburg, S. C., and Charlotte, N. C., which will receive and ship refined products.

Southeastern Connects With Plantation System

A connection has been made with Plantation Pipe Line Co. by Southeastern Pipe Line Co. which facilitates shipments of products for delivery to terminals of Gulf and Pure interests in North and South Carolina.

The connection has been effected by Southeastern's construction of 19 miles of 8-in. contracted by Williams Brothers Corp. from Southeastern's Chattahoochee, Ga., station to Plantation's Doraville, Ga., station. Adjacent to the latter's Doraville station, Southeastern has built six 35,000-bbl. tanks contracted by Chicago Bridge & Iron Co. to handle shipments for delivery through the Plantation trunk line.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Keystone High Bidder for Plantation Extension

War Assets Administration announced that eight bids have been received and opened for the pipe line built by Reconstruction Finance Corp. to extend the Plantation Pipe Line Co. system from Greensboro, N. C., to Richmond, Va. Cost of the section was approximately $4,000,000.

Keystone Pipe Line Co., Philadelphia, made the high bid, $477,000, for the line and all equipment. It submitted an alternative bid, however, of $125,000 for four pumping stations and all equipment required for these stations.

Second high bid was submitted by the Plantation Pipe Line Co., Atlanta, the wartime operator, for $425,000.

Other bidders were: S. Bender, Shreveport, La., $300,000; Lipsett, Inc., New York, $150,000; M. N. Landay Co., Pittsburgh, $331,716; Williams Brothers, Washington, $375,000.

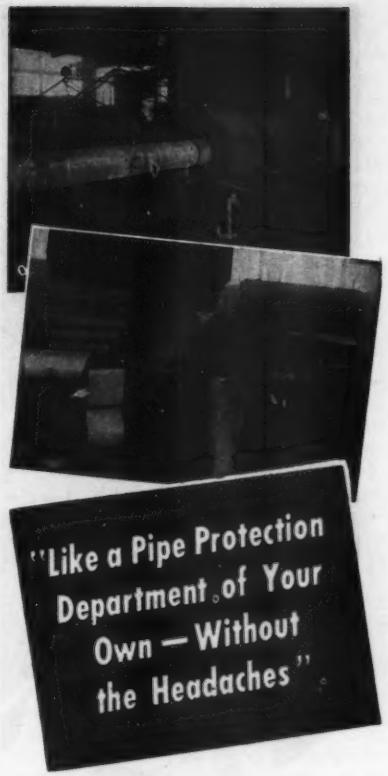
The RFC extension of the Plantation line consists of 179 miles of 8-in.

California Systems Expand Pipe Lines

Completed and in operation is an 8-in. and 10-in. pipe line, installed jointly by Southern California Gas Co. and Pacific Gas & Electric Co., connecting with P.G.&E.'s 16-in. Buttonwillow line which runs between Buttonwillow and Kettleman Hills, Calif.

Construction is about to start for a 10-in. and 12-in. line to tie-in the Buttonwillow line with Southern Cal.'s 26-in. and Pacific Lighting's 20-in. Kettleman Hills lines about 11½ miles west. A 6-in. and 8-in. line is planned to connect the Trico field extension with the towns of Porterville and Delano.

The pipe line already completed is the third line which brings gas out of Trico field, that is considered to more than double the original known reserves of this important producing area. The original Trico field was discovered in 1934. A deeper zone was



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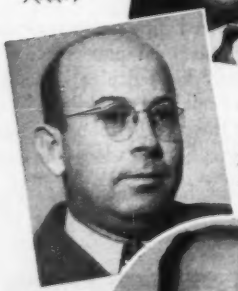

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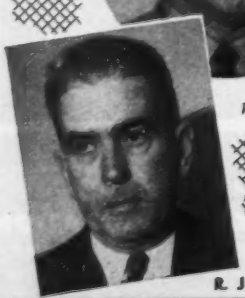

R. J. O'CONNELL

DALLAS, TEXAS

discovered in 1935, but the wells were on the edge of the zone and went to water.

In 1945, this deep zone was rediscovered in a more favorable structural position, and in February 1946 a large extension of the upper zone was found to the north.

Magnolia Prepares For Products Line

Magnolia Pipe Line Co. will issue specifications early in April for construction of approximately 150 miles of 12-in. products line from Spindletop to Hearne, Tex., according to reports. Bids for construction, divided into two sections, will be received in the middle of April. Construction is expected to commence in June. The system will be extended from Hearne to a point near Dallas by 150 miles of 10-in. to be built by Texas Pipe Line Co.

Specifications for construction of Magnolia's 650-mile, 20-in. Corsicana, Tex.-Patoka, Ill., crude-oil line will probably not be issued until the middle of the summer. Pipe laying may start in July and is likely to be well under way in early autumn.

Radio Aids El Paso Co.'s Texas-California Pipe Laying

Two-way short-wave radio aids in expediting construction of the El Paso Natural Gas Co. feeder lines and its 26-in. main line from the Jal, N. M., area to California.

The radio units consist of a fixed 50-watt station at Jal and 30-watt mobile stations in 10 motor vehicles. Installation was authorized by the Federal Communications Commission.

The system enables drivers of the 10 vehicles to communicate with each other and with the station in Jal.

Fire Damages Blackwell Station

A fire at 7 p.m. March 9 severely damaged the compressor plant, auxiliary plant, cooling system, and office building in a disaster which killed one man and injured five at the Blackwell (Okla.) station of Cities Service Gas Co. Serious damage to property resulted.

A break in the pipe is reported to have occurred in a header during operation at 450 psi. Gas is said to have ignited as a result of contact with machinery in the plant.

Temporarily the total gas throughput via Blackwell will be reduced from 100,000,000 to 50,000,000 cu. ft. daily. The company's line from Hugoton to Caney, Kans., with capacity of 200,000,000 cu. ft. was not affected by the accident since it bypasses the Blackwell station.

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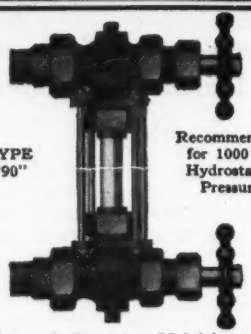

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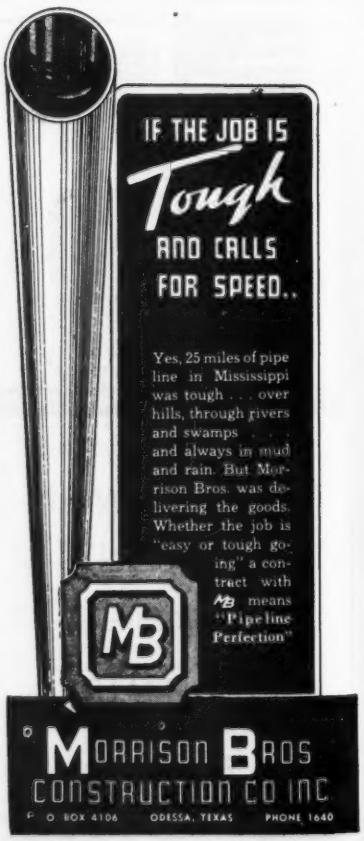

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NATURAL GAS

Inch Allocations Changed; Uninterrupted Use Asked

SLIGHT changes in the allocation of natural gas from the Big Inch pipeline system became effective this week as a result of recommendations of the Federal Power Commission's industry-advisory committee which were unanimously accepted by FPC.

A total of 130,000,000 cu. ft daily is expected to be available from the Big Inch during March compared to 125,000,000 cu. ft. daily in February. Daily deliveries anticipated under the new allocation during March, and February deliveries to distributing companies follow: Panhandle Eastern Pipe Line Co., 20,000,000 cu. ft., unchanged; Columbia Gas & Electric Corp., 47,000,000 cu. ft. against 47,900,000 cu. ft.; Consolidated Natural Gas Co., 33,000,000 cu. ft. against 33,700,000 cu. ft.; National Fuel Gas Co., 13,500,000 cu. ft. against 10,200,000 cu. ft.; Equitable Gas Co., 15,000,000 cu. ft. against 10,200,000 cu. ft.; Carnegie Natural Gas Co., 1,500,000 cu. ft. unchanged. Louisville Gas & Electric Co., which received 1,500,000 cu. ft. daily in February, was not listed in the March allocation.

Natural gas from Texas and Louisiana fields is now being drifted to eastern consuming areas by Tennessee Gas & Transmission Co. under an emergency lease of the lines which expires April 30. The industry advisory committee, headed by Gardiner Symonds, president of T.G.&T., at its meeting in Washington last week, asked FPC to "exercise its best efforts" to have the Big Inch system continued without interruption after expiration of the lease and to expedite construction of facilities such as compressor stations to increase the movement of gas to Appalachian area.

High bidder for the lines at the War Assets Administration sale last month was Texas Eastern Transmission Co. The sale has been approved by the Department of Justice, and Texas Eastern has announced plans to attempt to continue the emergency deliveries on expiration of the T.G.& T. lease.

January Natural-Gas Sales Up 9.6 Per Cent

Utility sales of natural gas in January increased 9.6 per cent over January 1946 to total 2,649,346,000 therms, according to the American Gas Association.

The association's index of natural-gas sales stood at 216.6 per cent of the 1935-1939 average. In the 12 months ended January 31, 1947, natural-gas sales were 1.2 per cent above the corresponding year-earlier period. Total sales for the 12 months ended January 31, 1947, were 22,960,720,000 therms.

Total January sales of all types utility gas to ultimate consumers were 3,069,994,000 therms, an increase of 10.1 per cent over January 1946. For all types gas sales, the A.G.A. index stood at 215 per cent.

At the same time, the association reported on gas-industry statistics for the final 1946 quarter. For all types of gas, there were 20,900,000 customers on the mains at the end of the year, a gain of 2.9 per cent. Natural-gas sales were up 8.5 per cent in the quarter.

A.G.A. Proposes Changes In Constitution, By-Laws

Ballots on proposed constitutional amendments enlarging the executive board by nine membeers, setting up an executive committee, and revamping the method of approving and paying bills have been submitted to members of the American Gas Association.

Mail ballots must be voted before April 1. A two-thirds vote of members is necessary to amend the constitution and by-laws.

FPC Hearings in Kansas City To Resume March 19

WASHINGTON.—The Federal Power Commission has set March 19 for resumption of the hearing on construction applications for pipe-line facilities by Mid-Continent Gas Transmission Co., Cities Service Gas Co., and Northern Natural Gas Co., and on a rate schedule filed by Cities Service. The hearing will reopen in the City Hall, Kansas City, Mo.

The applications are: Mid-Continent, for authorization to construct an 836-mile pipe-line system from Liberal, Kans., through Kansas City to St. Paul, Minn.; Cities Service for authorization to construct facilities to increase its delivery capacity to supply gas to the areas around Wichita and Kansas City; and Northern Natural, for extensive additions to increase its delivery capacity to serve the areas north of Clifton, Kans., and in Iowa and Minnesota. The proposed Cities Service rate schedule would require the company's distributing affiliates to buy their entire gas requirements from Cities Service.

Motion to Make Phillips Party in Gas Case Denied

WASHINGTON.—The Federal Power Commission has denied a motion of the City of Detroit to make Phillips Petroleum Co. a party to the proceedings in which Michigan-Wisconsin Pipe Line Co. was authorized by the commission to construct initial facilities, subject to certain conditions, of a natural-gas transmission system extending from Texas to Wisconsin and Michigan. Phillips Petroleum, a producing company, is to supply the gas for the new line.

The motion filed by the City of Detroit requested the commission to issue an order requiring Phillips Petroleum to show cause why it should not be required to apply to the commission for a certificate of public convenience and necessity authorizing the construction and operation of the facilities which are proposed to be installed to deliver and sell gas to Michigan-Wisconsin Pipe Line, and also requiring Phillips Petroleum to disclose the extent of its gas reserves.

Canadian Association Sets May Meeting

CHATHAM, Ont.—The twenty-first annual convention of the Natural Gas and Petroleum Association of Canada will be held at the Royal Connaught Hotel, Hamilton, Ont., May 22-23.

Natural Gasoline

Natural-Gasoline Output Shows Increase in 1946

Production of natural gasoline and allied products increased 362,000 gal. daily during 1946 with a daily average production for the year of 13,250,000 gal. against a daily average output of 12,888,000 gal. during 1945.

December production averaged 14,227,000 gal. daily, compared with a November daily average of 14,007,000 gal.

Stocks at plants, terminals, and refineries totaled 209,209,000 gal. on December 31, a drop of 21,235,000 gal. from the total on November 31 but 27,696,000 gal. above the year-end total of 1945.

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UNIFIED CONSTRUCTION OF INDEPENDENT CUTTER SUPPORTS MEANS *faster and safer drilling*

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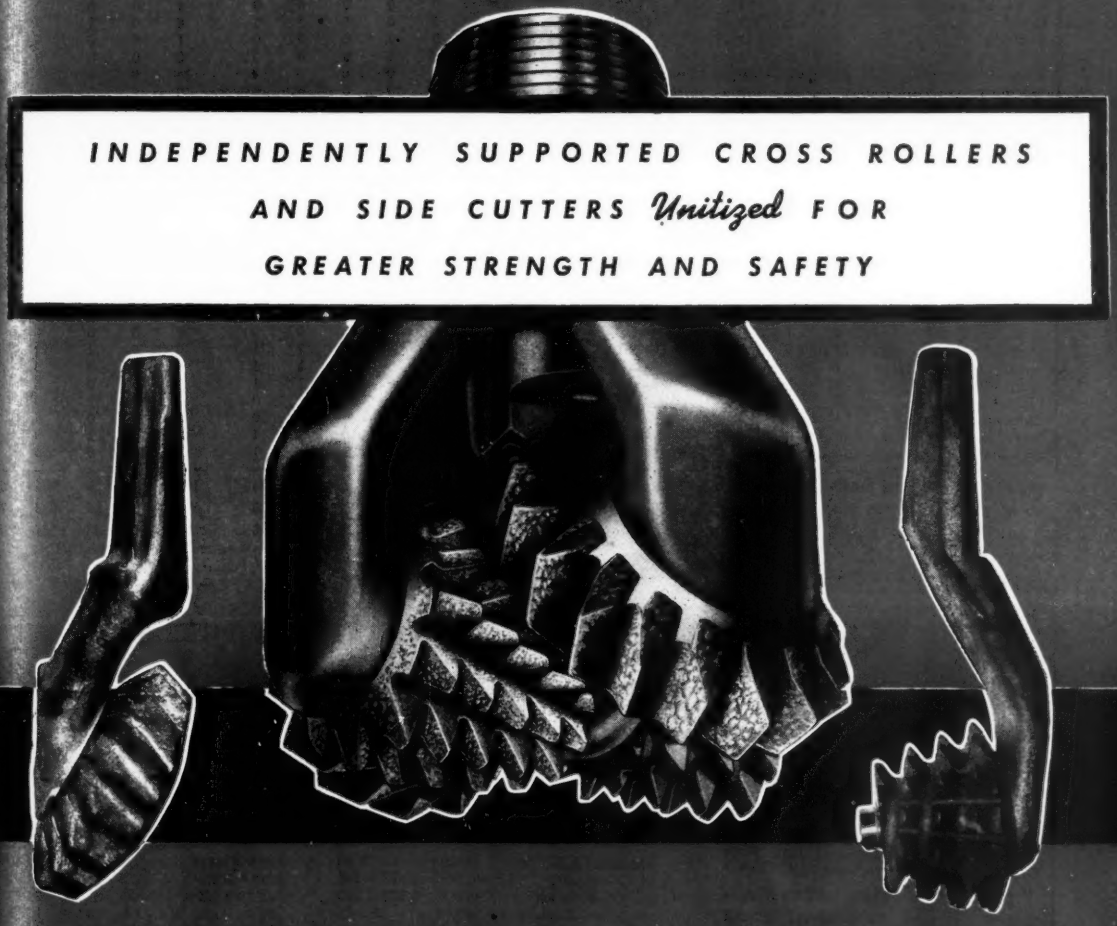

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STATISTICS and T

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 8, 1947

	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1947				
	Comp.	Oil	Gas	Dry	Footage	1947	1946	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	24	13	0	*11	38,423	264	290	0	0	0	0	0	0	0	0	0	0
Pennsylvania	59	31	3	†25	89,684	613	806	0	0	0	0	0	0	0	0	0	0
West Virginia	20	0	17	3	72,302	165	118	0	0	0	0	0	0	0	0	0	0
Ohio	14	3	7	4	44,884	224	197	0	0	0	1	1	0	0	1	8	9
Indiana	8	6	1	1	15,764	72	55	0	0	0	0	0	1	0	0	5	6
Kentucky	7	1	3	3	17,300	71	79	0	0	0	0	0	0	0	0	8	8
Illinois	35	23	0	12	84,404	354	353	2	0	0	5	7	14	0	0	55	69
Michigan	11	3	0	8	22,164	122	124	0	0	0	6	6	0	0	3	49	52
Kansas	62	23	16	23	190,872	504	380	0	0	1	7	8	8	0	5	57	70
Neb., Mo., Iowa	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	1	1
Oklahoma	83	52	5	26	241,662	766	452	4	0	0	7	11	21	0	1	141	163
Texas‡	151	100	10	41	707,250	1,477	1,409	6	2	0	27	35	48	7	12	236	303
North Central	37	19	1	17	110,646	468	480	3	0	0	8	11	22	0	4	87	113
West	40	37	0	3	187,597	374	301	2	0	0	2	4	5	0	1	33	39
Panhandle	7	5	2	0	21,737	84	72	0	0	0	0	0	1	0	0	0	1
Eastern	12	6	1	5	59,493	88	130	0	0	0	4	4	1	0	0	22	23
Gulf Coast	26	16	2	8	177,781	279	331	0	0	0	6	6	11	5	6	47	69
Southwest	29	17	4	8	149,996	184	95	1	2	0	7	10	8	2	1	47	58
Louisiana‡	22	17	1	4	135,690	207	240	2	2	0	2	6	9	6	0	26	41
Northern	10	7	1	2	29,698	96	119	0	0	0	1	1	0	0	0	15	15
Southern	12	10	0	2	105,992	111	121	2	2	0	1	5	9	6	0	11	26
Arkansas	4	4	0	0	21,909	38	34	0	0	0	0	0	0	0	0	6	6
Mississippi‡	11	10	0	1	100,974	65	43	0	0	0	1	1	0	0	1	19	20
Southeastern States	1	0	0	1	4,633	10	11	0	0	0	1	1	0	0	0	9	9
Montana	3	1	1	1	5,852	30	48	0	0	0	1	1	0	0	0	5	5
Wyoming	1	1	0	0	2,905	44	38	0	0	0	0	0	3	0	1	9	13
Colorado-Utah	4	4	0	0	27,052	27	21	0	0	0	0	0	1	0	0	6	7
New Mexico‡	10	8	1	1	57,152	92	74	0	0	0	1	1	2	0	1	9	12
California	45	34	2	9	191,859	376	333	0	0	0	7	7	2	0	0	55	57
Total United States	575	334	67	174	2,072,735	5,522	5,109	14	4	1	66	85	109	13	25	704	851
Total previous week	542	286	60	196	1,956,017	4,947	4,612	10	1	0	75	86	95	9	24	638	766
Total Mar. 9, 1946	497	256	54	187	1,705,945			7	0	1	60	68	82	2	23	557	664

Service wells included: *11, †23. ‡Cumulative figures revised.

MARKET QUOTATIONS

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$1.17			
19-19.9	1.21			
20-20.9	1.24			
21-21.9	1.28			
22-22.9	1.32			
23-23.9	1.35			
24-24.9	1.39			
25-25.9	1.43			
26-26.9	1.46			
27-27.9	1.50			
28-28.9	1.54			
29-29.9	1.57			
30-30.9	1.61			
31-31.9	....			
32-32.9	....			
33-33.9	....			
34-34.9	....			
35-35.9	....			
36-36.9	....			
37-37.9	....			
38-38.9	....			
39-39.9	....			
40 and above	....			

FOR LATEST ADVANCES IN THESE PRICES, SEE PAGE 52

(Quotations shown here are f.o.b. plant in tank cars and in cents per gal. as of last Monday.

REFINERY GASOLINE

Octane (A.S.T.M.)	78-80†	73-75
Mid-Continent*	7.500-7.750	6.875-7.250
Tex. Gulf Coast	7.50-7.75	6.750-7.125
New York Harbor	9-10.75	8-9.25

*Basic Oklahoma Group 3 †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades—	26-70	18-55
Oklahoma (Group 3)	5.125	6.150
N. Texas (f.o.b. plant)	4.625	5.550
N. Louisiana (f.o.b. plant)	4.875	5.850

CRUDE-OIL PRICES

Representative posted schedules per bbl.

Kettleman Hills, California*	1.69
Bradford, Pennsylvania	3.65

FOR LATEST CRUDE OIL PRICES IN OTHER AREAS, SEE PAGE 52

A.P.I. REFINERY REPORT

Week ended March 1, 1947
(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gasoline	Distillate	Residual
East Coast	772	22,740	13,130	6,963
Appalachian	175	3,742	507	321
Ill., Ind., Ky.	825	21,731	2,823	2,441
Okla., Kan., Mo.	390	10,538	1,311	1,017
Inland Tex.	237	4,537	318	763
Tex. Gulf Cst.	1,149	16,025	6,535	5,133
La. Gulf Cst.	352	5,208	2,054	1,601
N. La., Ark.	60	2,319	454	132
Rocky Mt.	133	2,964	509	781
California	803	15,999	10,363	26,013
Total 3- 1-47	4,896	105,803	38,004	45,175
Total 2-22-47	4,860	103,904	40,739	44,919
Total 3- 2-46	4,813	104,773	25,455	38,495

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended—	Bbl. of crude*
March 1, 1947	225,131,000
February 22, 1947	224,580,000
March 2, 1946	229,430,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	Mar. 8 crude oil	B. of M. Mar. demand	Mar. 1 crude oil
Alabama	950	1,200	900
Arkansas	80,750	79,000	79,950
California	899,500	850,000	899,700
Colorado	38,020	38,000	38,040
Eastern	61,000	64,200	63,400
Florida	125	200	115
Illinois	193,600	210,000	196,200
Indiana	17,300	18,000	18,000
Kansas	255,550	270,000	271,800
Kentucky	26,600	29,000	27,500
Louisiana	413,150	400,000	411,700
North Louisiana	101,700	.....	101,400
South Louisiana	311,450	.....	310,300
Michigan	43,405	47,000	44,135
Mississippi	87,295	77,000	84,985
Montana	22,560	24,000	22,550
Nebraska	700	700	700
New Mexico	103,900	101,000	103,400
Oklahoma	366,400	375,000	369,150
Texas	2,129,750	2,060,000	2,056,665
District 1 (Southwest)	20,550	.....	19,950
District 2 (Southwest)	157,900	.....	146,025
District 4 (Southwest)	242,000	.....	223,250
District 3 (Gulf Coast)	487,300	.....	451,000
District 5 (Eastern)	38,290	.....	36,440
District 6 (Eastern)	110,995	.....	106,100
East Texas field	313,000	.....	328,200
District 7-C (West)	34,892	.....	32,665
District 8 (West)	473,725	.....	467,455
District 7-B (W. Central)	36,425	.....	36,100
District 9 (N. Central)	130,000	.....	126,355
District 10 (Panhandle)	84,675	.....	83,125
Wyoming	106,320	100,000	107,840
Miscellaneous	.....	700	.....
Total United States	*4,846,875	4,745,000	4,796,730
Change from prev. week	up 50,145		

Total production January 1-March 8 ..... †318,184,315 bbl.
Same period last year (crude plus condensate).. 317,748,450 bbl.
*Not incl. 25,000 bbl. condensate. †Incl. 1,723,080 bbl. condensate.

CRUDE-OIL STOCKS 225,131,000 bbl. as of March 1—up 551,000 bbl. One year ago 229,430,000 bbl.

GASOLINE STOCKS 105,803,000 bbl. as of March 1—up 1,899,000 bbl. One year ago 104,773,000 bbl.

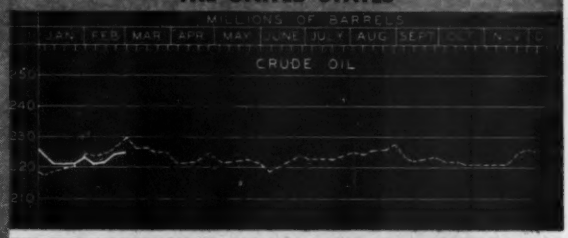
RESIDUAL FUEL-OIL STOCKS 45,175,000 bbl. as of March 1—up 256,000 bbl. One year ago 38,495,000 bbl.

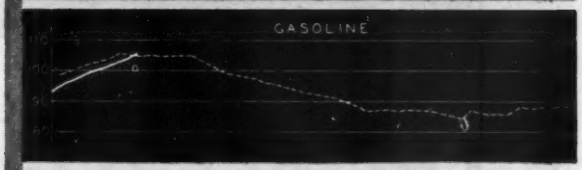
GAS OIL AND DISTILLATE STOCKS 38,004,000 bbl. as of March 1—down 2,735,000 bbl. One year ago 25,455,000 bbl.

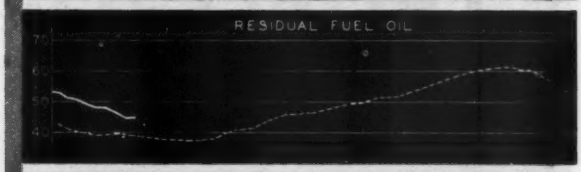
CRUDE-OIL PRODUCTION 4,846,875 bbl. as of March 8—up 50,145 bbl. One year ago 4,389,310 bbl.

REFINERY RUNS 4,896,000 bbl. daily week ended March 1—up 36,000 bbl. One year ago 4,813,000 bbl.

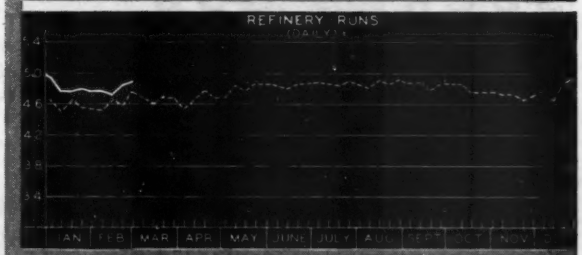
OIL STOCKS IN THE UNITED STATES



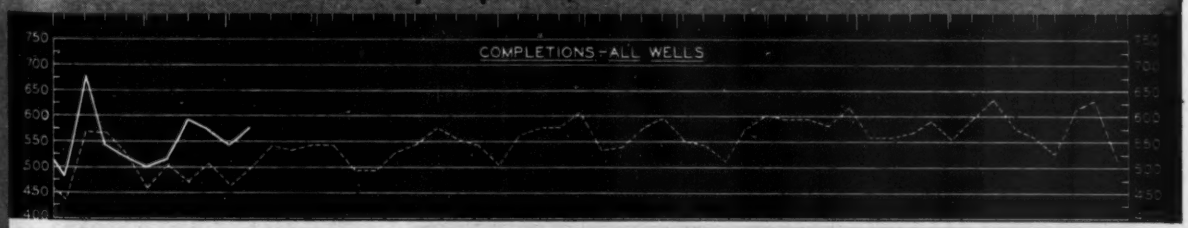


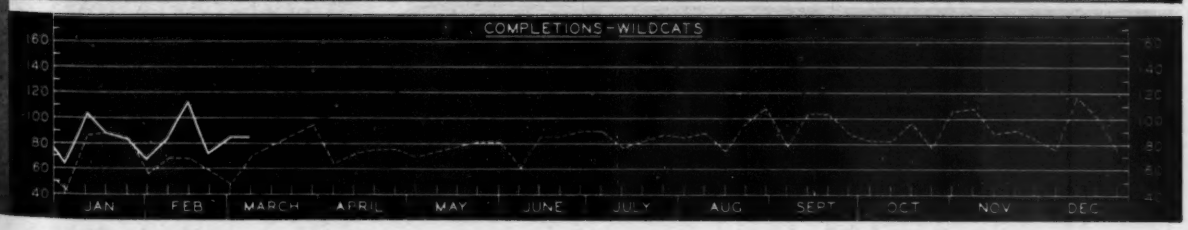


DAILY OPERATIONS



Solid line charts weekly completions, service wells in Eastern area included.





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One important division of the W. C. NORRIS plant is the section where sucker rods are made . . . where the several types of selected and proven steels are forged and threaded to exact A. P. I. specifications.

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High quality, basic open hearth, close grained carbon steel. Fully normalized. A. P. I. specifications. Box and Pin and Double Pin types. For medium pumping duty.

NORRIS Type 30
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Very high grade, basic open hearth carbon manganese steel. Fully normalized. A. P. I. specifications. Box and Pin and Double Pin types. For heavy pumping duty.

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Selected nickel moly alloy of great strength, ductility and toughness. Definite corrosion resistance. Fully normalized and tempered. A. P. I. specifications. Double Pin type. For heavy pumping duty of corrosive crudes.

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Selected high nickel moly alloy with extra resistance to shock and corrosion fatigue, combined with strength and ductility. Fully normalized and tempered. A. P. I. specifications. Double Pin type. For heavy pumping duty of highly corrosive crudes.

For complete, detailed information write for Bulletin 28-B—covering SUCKER RODS, POLISHED RODS, PULL RODS and COUPLINGS

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Exploration and Drilling

Lindsay Play Gets Good Wells

JUSTIFICATION for the active drilling campaign going on east of the Lindsay pool in the southwest corner of McClain County, Oklahoma, was developed this week in encouraging results in two wells. The most important was Carlock et al 1 Harrison, N/2 SE 25-5n-4w, which flowed 100 bbl. per hour of 44°-gravity oil through a ¾-in. choke, with gas-oil ratio of 1,800 cu. ft., from perforations in the Ordovician Bromide at 10,430-40 ft. and 10,445-85 ft.

R. L. Bauman 1 Ainsworth, NE NW SE 26-5n-4w, the second well, was rated at 662 bbl. per day from Hunton lime at 9,892-9,940 ft. A third well, Magnolia Petroleum Co. 1 Martin, NW NE 1-4n-5w, ran a 10-minute drill-stem test at 7,655-90 ft. and 350 ft. of oil-cut and gas-cut mud, about 50 per cent oil. The Magnolia well is drilling ahead, but the show is reported to have been commercial.

The Carlock well, after flowing 100 bbl. for 4 hours through the ¾-in. choke with 1,800 cu. ft. gas-oil ratio, was put on a 7/16-in. choke for a second 4-hour test, and flowed 51 bbl. per hour, gas-oil ratio reduced to 1,500 cu. ft. On a third 4-hour test, with choke reduced to 3/16 in., it flowed 27 bbl. per hour, with gas-oil ratio cut down to 1,200 cu. ft.

There are nearly 20 wells and locations southeast of the original discovery well in the Lindsay pool, and the performance of this week indicates that the interpretation of the geology that led to such a heavy concentration and fast stepout for such deep drilling is going to stand the acid test, and produce oil.

All of this adds up to a gradual unraveling of the local details of the geology of the southeastern end of the Anadarko basin and interpretation of that geology to find producing oil wells. The area east from Lindsay toward Pauls Valley is gradually filling in with oil fields. The area north from Lindsay toward West Moore and South Moore, and northeast toward the western edge of the Seminole district is gradually being interpreted.

The more the details of the geology of the southeastern end of the Anadarko basin are developed and understood in terms of finding oil, the easier it will be to work gradually northwest through the whole basin, if the major portion of the basin contains oil, as so many geologists believe.

N. CENTRAL TEXAS

Warren Oil's 1 Martin Shows for Gas Discovery

WICHITA FALLS.—Warren Oil Corp. 1 Martin, 7½ miles northwest of Eliasville, M. DeWitt Survey, in Young County, was showing for a gas discovery last week when it made perforations at 4,212-17 ft. Total depth was 4,842 ft., in the Ellenburger topped at 4,660 ft. A show of oil was reported at 4,208-38 ft. in conglomerate.

Another Caddo limestone pool was indicated for Stephens County at L. C. Harrison et al 1 Chaney, 12 miles southwest of Breckenridge. A drill-stem test at 3,350-65 ft. put gas to the surface in 1 minute, and oil to the surface in 16 minutes. The well was allowed to flow for 24 minutes but no report was made on the amount of oil made. Location is some 2 miles east of Manning and Sinclair's 1 Adolph-Mueller, which found production in the Caddo.

Ten miles southwest of Breckenridge, Fred M. Manning 1 A. W. Mueller flowed 78 bbl. of oil, with no water, through ¼-choke in 24 hours from the Caddo at 3,361-66 ft. Total depth was 4,232 ft.

New Ellenburger production for east central Callahan County was found at Andrade, Kramer & Brachman's 1 J. D. & J. P. Isenhower, 3 miles southeast of Putnam. Preliminary tests after acidizing made 75 bbl. of oil and 25 bbl. of salt water, on the pump, in 24 hours. The Ellenburger was topped at 3,932 ft., with total depth at 3,980 ft.

NORTH CENTRAL TEXAS SUCCESSFUL WILDCATS

Jack County: Warren Oil Corp. 1 J. D. Gillespie "C," J. B. McNeil Sur., 5 mi. N Jermyn, pumped 20 bbl. oil a day, limestone 5,515-20 ft., TD.

Young County: Lloyd Oil Co. 2 Sally R. Donnell, J. C. Sheldon Sur., 2 mi. E Eliasville, flowed 32 bbl. 40°-gravity oil in 8 hours, 20/64-in. choke, casing pressure 300 lb., tubing pressure 100 lb., pay 2,328-40 ft., TD.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: W. T. Graham 1 W. L. Harris, Sec. 3, Hooper & Wade Sur., 4 mi. SE Dundee, dry, TD 5,305 ft., Barnett 5,080 ft., Mississippian 5,144 ft., Ellenburger 5,280 ft.

Cooke County: J. F. Hood et al 2 Luttmer, Saunders Sur., 3 mi. SW Muenster, dry, TD 1,813 ft. in sand.

McCurdy Bros. 1 Cunningham Bros., John T. Hill Sur., 2½ mi. NE Valley View, dry, TD 1,959 ft. in hard limestone and sand.

Wilbarger County: National Associated Petroleum Co. 1 Roy Abbott, M. Sams Sur., 4 mi. N Tolbert, dry, TD 5,615 ft. in limestone, no tops reported.

WEST CENTRAL TEXAS SUCCESSFUL WILDCAT

Fisher County: Ellis A. Hall 1 J. D. Terrell, Sec. 80, Blk. 1, H&TC Sur., 3 mi. NE Royston, flowed 307 bbl. initial, 8/64-in. choke, 40°-gravity, limestone pay topped 4,885 ft., TD 4,942 ft., PB 4,935 ft.

WEST CENTRAL TEXAS WILDCAT FAILURES

Callahan County: Hedrick Oil Co. 2 R. D. Williams, Sec. 64, Rayland Orphan Home Land, 8 mi. NE Baird, dry, TD 855 ft. in shale.

Fisher County: H. F. Pettigrew 1 R. Herbst, Sec. 40, Blk. 1, H&TC Sur., 3 mi. SE Sylvester, dry, TD 4,863 ft., Dothan lime 2,700 ft., Noodle Creek 2,820 ft.

Palo Pinto County: W. F. Powell et al 1 S. D. Pierce, Sec. 1,707, TE&L Sur., 2½ mi. SW Graford, dry, TD 2,200 ft.

Taylor County: The Texas Co. 1 K. P. Hamilton, J. W. Page Sur. A-123, 3 mi. SE Merkel, dry, TD 2,795 ft., Saddle Creek 2,420 ft., Flippen 2,470 ft., Gunsight 2,778 ft., elev. 1,832 ft.

EASTERN TEXAS

Anderson County Discovery Drilling Below 5,795 Ft.

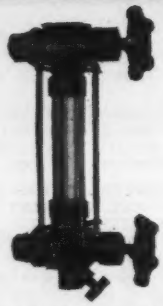
DALLAS.—Anderson County's new dry-gas discovery, or 1-mile north extension of the one-well Hemby field, was drilling ahead below 5,795 ft. after making a good blow of gas from the Woodbine at 5,527 ft. A drill-stem test at that depth, through ¼-in. chokes, built up a flowing pressure of 1,300 lb. in 4 minutes.

In Cherokee County, Standard Oil Co. of Texas 1 New Birmingham Development Co., plugged back to 9,170 ft. from total depth of 10,017 ft. and ran 2-in. tubing with packer set at 9,060 ft. Perforations in the James limestone at 9,092-9,168 ft. returned wash water on swabbing tests, with a show of gas and distillate. First perforations between 9,156-68 ft. returned a good blow of gas on drill-stem test, recovered 1,000 ft. of distillate and gas-cut water, plus 250 ft. of straw-colored distillate in 25 hours. Gas flow was estimated at 50,000 cu. ft. a day. Tests were resumed on the lower perforations.

Magnolia Petroleum Co.'s 1 Hall Estate, 1 mile north of the Lassater field discovery, squeezed perforations at 9,644-47 ft., and plugged back to 9,696 ft., from total depth of 10,241 ft. Perforations and tests were to be made at 9,686-89 and 9,644-47 ft.

New work planned or getting under way include Phillips Petroleum Co.'s offset to Delta Drilling Co.'s Boynton, Paluxy sand discovery well in northern Smith County. Phillips' test will be the 1 B. O. Curry, on a 66-acre tract in the J. A. Malone Survey, offsetting the discovery to the northeast. Delta's producer found the pay sand at 7,512-28 ft. Location is 2 miles east of

PENBERTHY
"ALL IRON"
LIQUID LEVEL GAGES



Body made from a special high strength alloy iron, shanks alloy steel and trim stainless steel. Extra heavy construction throughout, automatic and positive shut-off if glass breaks, heavy duty stuffing boxes. Conform with A.P.I.—A.S.M.E. requirements.

The "All Iron" is one of the complete line of Penberthy gages that meet every liquid level gage requirement.

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DETROIT, MICH. Canadian Plant WINDSOR, ONTARIO

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Paluxy sand production at Mount Sylvan, but the two areas are separated by a dry hole. Tide Water Associated Oil Co. and Seaboard Oil Co. have made location for a Paluxy sand test at their 1 Dalby & Joiner, in the Douglas Puckett Survey A-484, in western Bowie County. The Paluxy is expected around 4,800 ft. H. W. Snowden was reported moving in a heavy rig to deepen the 1 Robertson, Chancey Couch Survey, south of Carlisle in Rusk County. Old total depth is 4,850 ft. in the Georgetown limestone, topped at 3,840 ft.

EAST TEXAS WILDCAT FAILURES

Hill County: A. P. Merritt 1 Henry Nors, F. A. Tabor Sur., 3 mi. SE Aquilla, dry, TD 3,125 ft. Trinity, with show of oil 1,600-50 ft., base cap rock 2,900 ft.

Limestone County: Gregg-Tex Gasoline Corp. 1 Baker, W. D. Smith Sur., 7 mi. SE Mexia, dry, TD 8,006 ft., sample tops: Austin 3,160 ft., Woodbine 4,070 ft., upper Glen Rose 5,595 ft., Massive 6,550 ft., Pettit 7,170 ft., Travis Peak 7,370-80 ft., elev. 514 ft.

Nacodoches County: H. W. Snowden 1 Gray & Mast, J. A. Chireno Sur., 1½ mi. S Chireno, dry, TD 775 ft.

Navarro County: Daily Goodson et al 1 C. T. McDowell, T. J. Jordan Sur., 2 mi. N Kerens, dry, TD 3,762 ft., Pecan 1,525 ft., Woodbine 3,180 ft., sample tops.

SOUTHWEST TEXAS

Starr County Discovery Flows 38 Bbl. Daily

CORPUS CHRISTI.—Coastal Refineries, Inc. and W. D. Kennard 1 Coates & Vessels, new discovery in Starr County, east of Boyle field and south of Rincon field, flowed 38 bbl. of 45°-gravity oil per day through a 3/16-in. choke, with no water in the flow, and gas-oil ratio of 400. Production was through perforations from 3,870-82 ft. Total depth 4,319 ft., with 5½-in. casing set to 3,906 ft. Operators are preparing to test this pay in their 1 M. M. Garcia, in the southeast corner of Share 1, Porcion 93, a north offset to the 1 Coates & Vessels.

Approximately 1½ miles west of Alice field in Jim Wells County, Southern Minerals Corp. is swabbing in a new oil discovery. Their 1 S. B. Alley, in southeast corner of Lot 23, L. G. Collins Farm Lots, C. C. I. Co. Survey, swabbed 95 per cent oil and 5 per cent fresh water on a drill-stem test, with no working pressure, through perforations from 5,045-55 ft. and recovered 350 ft. of oil and 150 ft. of oil and mud on the test. Tubing has been run for completion. Total depth is 5,510 ft., with 5½-in. casing at 5,110 ft.

Magnolia Petroleum Co. 1 McKinley, 6½ miles northeast of Pearsall, in M. C. Davidson Survey, Frio County, is drilling below 5,018 ft. after drill-stem test at 4,973-84 ft., using ¼-in. chokes, developed a slight blow, and recovered 15 ft. of oil-cut mud, in 20 minutes. The 13⅜-in. casing has been set to 4,220 ft. Scheduled depth is 12,000 ft.

A new pay for North Sun field, Starr County, has been opened by Sun Oil Co. 4 Lee M. Green. Drilled to a total depth of 6,996 ft., this well was completed as a small gasser through perforations from 6,470-80 ft. in a new deeper pay for the field. No gage has been run on the production as yet.

The 5,870-ft. pay in South Kelsey field, Starr County, has been extended 3,000 ft. to the northwest, by the Sun Oil Co. 1-A Vicenta L. de Pena. On an 11-hour gage the well flowed 38 bbl of pipe-line oil through a 7/64-in. choke, with 1,680-lb. tubing pressure. Total depth is 6,201 ft., and production is through perforations at 5,859-66 ft.

A new shallow gas pay has been opened at Midway field, San Patricio County, by British-American Oil 2 D. I. Coggin, rework job in an old dry hole. Original total depth was 6,505 ft. Operators cleaned out and set 5½-in. casing to 3,715 ft. for the gas completion through perforations from 3,647-62 ft. No gage has been taken, but it cleaned on a ¼-in. choke, with 1,100-lb. tubing pressure and 1,225-lb. casing pressure.

The 25 new locations reported this week included 13 wildcat starts, 3 in Duval and Nueces, 2 in San Patricio and Webb, and 1 each in McMullen, Medina and Williamson counties. Two new pays, one in Borregas pool and one in East Falfurrias pool in Kleberg County, were completed. One new pool discovery in Jim Wells County was also completed, while seven wildcats were dry, two each in Duval and McMullen, and one each in Webb, Williamson, and Zavala counties.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Jim Wells County: New gas-condensate pool—H. J. Mosser & W. R. Quin 1 Charles Muil, in Comanche Creek Irrigation Co. Sur., 6 mi. SW of Alice and 1½ mi. W of Alice field, TD 5,517 ft., top pay 5,012 ft., perf. 5,012-20 ft., IP 15 bbl. dark condensate and 1,400,000 cu. ft. gas per day through a 7/32-in. choke; estimated 8,000,000 cu. ft. gas per day on open flow, shut-in pressure 1,650 lb., TP 1,280 lb., CP 1,310 lb., no water.

Kleberg County: New oil pay, Borregas pool—Humble 7 King Ranch-Borregas, in Santa Gertrudis Grant, top pay 7,076 ft., TD 7,960 ft., perf. 7,076-81 ft., IP 95 bbl. oil per day through a ⅛-in. choke, gas-oil ratio 4,060, TP 1,900 lb., casing sealed, gravity 37°, 0.1 per cent water.

New gas-condensate pay, East Falfurrias pool—Shell Oil Co., Inc. 1 W. P. Wright, in El Paisano Ramon de la Garza Grant, 5 mi. SE of La Gloria, TD 10,310 ft., perf. 9,150-69 ft. and 9,195-9,207 ft., IP 6,400,000 cu. ft. gas and 95 bbl. con-

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SOUTHWEST TEXAS WILDCAT FAILURES

Duval County: Bridwell Oil 1 A. Morales, R. Fletcher Sur. 6, 3 mi. SE of Benavides, dry, TD 5,015 ft.

M. M. Miller & Sons 1 Atlee Parr, San Andres Grant, 1 mi. NE of East Longhorn field, dry, TD 6,373 ft.

McMullen County: O. D. Edwards, Jr. 3 Annie Graves Dolph et al, in Francisco Gomez Sur. 48, 17 mi. SE of Tilden, dry, TD 1,526 ft.

Harry Ezzell 4-A Harry Ezzell, in Henry M. Brewer Sur. 7, 11 mi. S of Caliham, dry, TD 1,689 ft.

Webb County: Westbrook Oil Corp. 4 Mabel Adami, in Lee Adami Sur. 336, 2½ mi. S of Adami field, dry, TD 1,802 ft.

Williamson County: H. C. Lefors 1 A. A. Galler, in Pedro Zarza Sur., 2½ mi. from Thrall, dry, TD 920 ft.

Zavala County: Adams & Lyles 1 B. H. Holsomback, in Francisco Pereyra Grant, 5½ mi. N of Crystal City, dry, TD 3,723 ft.

SOUTH LOUISIANA

Avery Island Field Gets New Producing Sand

NEW ORLEANS.—A new producing sand for Avery Island field of Iberia Parish has been opened by Humble Oil & Refining Co. 10 Petit Anse Co., Inc., 26-13s-5e. On an initial gage the well flowed 211 bbl. of oil daily through a 9/64-in. choke through perforations from 7,260-7,230 ft. Gravity of the oil is 35°. Total depth 8,077 ft., in salt. The 7-in. pipe was cemented at 7,473 ft.

Barnsdall Oil Co. 2 Long Bell Lumber Co., in the Longville discovery area of Beauregard Parish, ¼ mile northwest of the discovery, 1-6s-10w, is making a potential test after flowing an initial gage of 127 bbl. of pipe-line oil, 49°-gravity, through a 10/64-in. choke. This is the confirmation test for this area and is from a new deeper sand in the Cockfield, producing from open hole below the 5½-in. casing which was set at 8,570 ft. Total depth is 9,001 ft. The discovery well, 1 Long Bell Lumber Co., completed from Cockfield sands topped at 8,228 ft., with perforations from 8,236-53 ft. The company's third test in the area, 3 Long Bell Lumber Co., 6-6s-9w, ½ mile east of the discovery, is drilling in shale below 7,998 ft.

Sohio Petroleum Co. 4-B Claudius Fontenot, deep test on the west side of Bon Air field in Jefferson Davis Parish, 16-10s-6w, is cleaning through a drill-stem operation from new deep sands. Total depth is 10,660 ft., with 5½-in. pipe cemented to the bottom. On an initial test through perforations from 10,520-530 ft., the well flowed gas and salt water with 2,800-lb. pressure through ½-in. chokes. Squeeze jobs were made, and another test in the same level was cleaning through the drill stem using ¼-in. chokes, showing gas and wash water with 2,750-lb. pressure.

Magnolia Petroleum Co. 1 State-Mineral Lease 673, 6 miles out from Point Au Fer in the Gulf of Mexico offshore Terrebonne Parish, is drilling at 11,063 ft. in broken sand and shale, in sidetracked hole.

Magnolia 1-C Lutcher, wildcat test 4 miles northeast of Mud Lake production in Cameron Parish, 24-14s-11w, failed to show commercially on a third test, and pipe has been perforated for a new test from 11,300-310 ft. Total depth is 11,705 ft.

There were 10 new locations reported this week, all in proven areas, 2 in Jefferson Davis, and 1 each in Calcasieu, Iberville, Lafourche, Plaquemines, Rapides, St. Charles, St. Landry, and St. Martin parishes. Four successful exploratory tests were completed including one new pool for Jefferson Davis Parish and three new pays, one each in Alliance and Delta Duck pools in Plaquemines Parish, and one in South Jeanerette pool, St. Mary Parish. One wildcat in Vermilion Parish was dry.

SOUTH LOUISIANA SUCCESSFUL WILDCATS

Jefferson Davis Parish: New oil pool—Stanolind Oil & Gas Co. et al 1 T. S. Stegal, 21-9s-5w, on northwest flank of Welsh dome, TD 8,233 ft., top sand 6,843 ft., perf. 6,843-55 ft., IP 28 bbl. oil per day and 2,080,000 cu. ft. gas through 12/64-in. choke, gas-oil ratio 74,000, TP 2,500 lb., CP 2,550 lb., gravity 44.8°, no water.

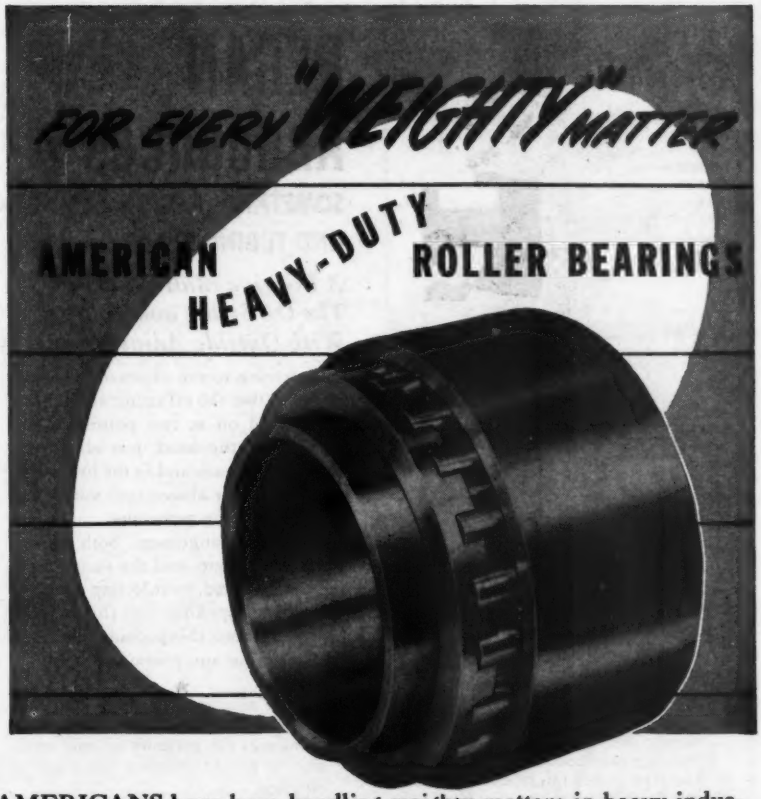
Plaquemines Parish: New condensate pay, Alliance pool—The California Co. 1 Louisiana Citrus Lands, Inc., 16-16s-24e, TD 9,800 ft., perf. 9,346-70 ft., in Miocene sand, IP no gage, shut in, TP 3,400 lb., 58°-gravity, no water.

New gas-condensate pay, Delta Duck pool—Texas Co. 13 Delta Duck Club Unit, St. Lse. 335, 31-20s-20e, TD 9,352 ft., perf. 8,678-8,714 ft., IP 77 bbl. condensate per day through 3/16-in. choke, gas-condensate ratio 16,285, TP 2,900 lb., gravity 46.7°-gravity, no water.

St. Mary Parish: New oil pay, South Jeanerette pool—Atlantic Refining Co. 1 Adeline Sugar Factory, 37-13s-9e, TD 7,675 ft., top sand 7,145-80 ft., perf. 7,163-68 ft., IP 110 bbl. per day through 9/64-in. choke, gas-oil ratio 476, TP 600 lb., gravity 34.2°, 0.1 per cent water.

SOUTH LOUISIANA WILDCAT FAILURE

Vermilion Parish: Union Oil Co. of Cali-



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fornia 1 Jan Jean LaFitte, 35-16s-2e, 1 mi. E of production in Fresh Water Bayou field, dry, TD 12,194 ft.

APPALACHIAN FIELD

Sylvania Test Tops Tully Lime at 1,895 Ft.

PITTSBURGH. — In Summit Township, Erie County, northwest Pennsylvania, Sylvania Corp. topped the Tully lime at 1895 ft. in a test on Alton F. Hugger farm. Surface elevation is 1,236 ft. placing the Tully at 659 ft. In the Oriskany gas discovery on the H. G. Hull farm, which started at an elevation of 1,200 ft., the Tully lime was topped at 1,860 ft. or minus 660 ft. with the interval to the top of the Oriskany 469 ft.

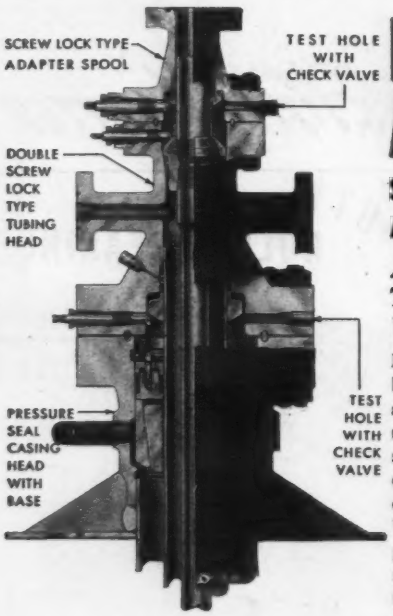
New locations in southwest Pennsylvania totaled four and were in West Franklin Township, Armstrong County; Porter and Red Bank townships, Clarion County; Bell Township, Westmoreland County.

In Ripley district, Jackson County, West Virginia, Columbian Carbon Co. completed 926 W. M. Riley 12 ft. in the Oriskany sand with a final open flow of 5,738,000 cu. ft. of gas. From surface elevation of 831 ft., the Corniferous lime was placed at 4,886 ft., Oriskany 5,002 ft., rock pressure 650 lb. 24 hours, total depth 5,014 ft. Here, this company topped the Corniferous lime at 4,680 ft. from surface elevation of 611 ft. in the test, 929 Frank Walters, and in Ravenswood district, the Corniferous lime at 4,850 ft. in the test 933 J. M. Sullivan.

In Elk district, Kanawha County, United Fuel Gas Co. completed a No. 5 or 5,760 Ego Gallati in the Oriskany sand which gaged 7,117,000 cu. ft. of gas, after shot. Surface elevation is 1,164 ft., Corniferous lime 5,386 ft., Oriskany 5,507-36 ft., gas 5,315-33 ft., shot 5,507-37 ft., rock pressure 728 lb. 48 hours, total depth 5,537 ft. In Big Sandy district, Falling Rock Producing Co. topped the Corniferous lime at 5,129 ft. in No. 78 fee with the surface elevation 856 ft.

In Logan district, Logan County, Columbian Carbon Co. is completing 935 Island Creek Coal Co. with the Big lime topped at 1,590 ft., show of oil at 1,415 ft., gas gaging 1,417,000 cu. ft. at 1,769-82 ft., and drilling at 1,783 ft.

New locations in West Virginia totaled 36 as follows: Sherman district, Calhoun County; Elk and Poca districts, Kanawha County; Harts Creek and Laurel districts, Lincoln County; Logan and Tridelphia districts, Logan County; Union districts, Marion County; Harvey and Kermit districts, Mingo County; Union district, Pleasants County; Pocatalico and Union districts, Putnam County; Clear Fork and Shady Springs district, Raleigh County; Clay and Grant districts, Ritchie County; Harper district, Roane County; Buchannon district, Upshur County; Stonewall district, Wayne County; Reedy district, Wirt County, and Baileysville district, Wyoming County.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CANADIAN FIELDS

Imperial Leduc 1 Continuing Tests

CHATHAM.—In the central Alberta plains area, Imperial-Leduc 1, LSD 22-50-26w4, finished in Devonian limestone at 5,066 ft., is continuing tests with production varying from 260 to 290 bbl. in 24 hours on ¼-in. choke. Imperial-Leduc 2, LSD 1, 16-50-26w4, 1¼ miles south and ¼ mile west of discovery, is below 3,000 ft. and Imperial-Leduc 3 has location in LSD 10, 26-50-26w4, about 2 miles northeast of discovery.

Leduc West 1 has location in LSD 6, 19-50-26w4, about 2½ miles west, and Globe-Leduc 1 is spotted in LSD 6, 5-50-26w4, about 3 miles southwest of discovery. Oil from the discovery well is 38° to 39° gravity with a low gas-oil ratio.

Turner Valley.—In Turner Valley field, Royalite Oil 86, LSD 12, 3-21-3w5, in the north extension area, is below 9,056 ft. with Madison limestone deep at 8,951 ft. Foothills Oil & Gas 11, LSD 11, 4-21-3w5, finished in 1941 at 7,422 ft., is deepening below 7,910 ft. in search of a lower porous horizon in the limestone. In the north central area, Royalite-Lowery 8 has location in LSD 9, 10-20-3w5. The other tests are drilling.

Jumping Pound.—The important Shell 5-7-1, LSD 5, 7-25-4w5, in the Jumping Pound area west of Calgary, is deepening in lower Benton formation below 6,771 ft. after getting the Cardium sandstone marker at 6,510 ft. Location is southeast of Shell 4-24J which has a wet-gas flow with a small oil recovery from the Madison limestone at 9,947 ft.

Medicine Hat.—In Medicine Hat field, southeastern Alberta, Medicine Hat 74, LSD 11, 15-13-6w4, has been completed at 1,250-ft. depth with initial open flow 2,498,500 cu. ft.

Steveville.—Testing the Devonian limestone area in the southern extension of the Steveville-Princess field, opened by South Princess Syndicate 2 last October, Standard Petroleum, which has taken over the syndicate, this spring will drill three offset wells to the same horizon. Two additional wells will be drilled as joint tests by Princess Petroleums and Pacific Petroleums, and Princess-Brooks Syndicate 3 has been located in 36-18-12w4, 2 miles south of the Devonian producer.

Provost.—In the Central Alberta plains area, Imperial-Provost 8, LSD 7, 28-38-

4w4, has been abandoned at 2,341 ft., after encountering noncommercial gas showings.

Hanna.—In the Hanna area, south-central Alberta, Berry Creek Petroleums 1, LSD 3, 9-31-14w4, is deepening after getting the Madison limestone at 3,675 ft., and will probably be carried down to test the Devonian formation. A gas flow, believed commercial, was cased off around 3,200 ft.

Northeast of Hanna and north of Youngstown, Standard Oil Co. of California and allied interests have secured three extensive reservations for development. These include 179,040 acres in townships 31-33, ranges 7 to 10w4; 195,360 acres in townships 31-35, ranges 9 to 12w4, and 198,700 acres in townships 33-35, ranges 5 to 8w4, with a further reservation of unspecified area in townships 35-37, ranges 8 to 13w4. The area is roughly about 48 miles square, and extends west from a point 25 miles west of the Albert-Saskatchewan boundary.

PERMIAN BASIN

Deep Penwell Test Flows 1,032 Bbl. in 24 Hours

MIDLAND.—Gulf Oil Corp. 1-E-A University-Goodson, Section 7, Block 35, University Lands, deep test in the shallow Penwell area of southern Ector County, last week made a 24-hour flowing test of 1,032 bbl. of 41.6°-gravity oil, plus 100 bbl. of water, from the Ellenburger at 8,925-35 ft. The flow was made after washing with 500 gal. of mud acid, and the water was believed to be acid water and not from the formation. Flow was through ⅜-in. tubing choke, with a gas-oil ratio of 711:1. Previously this test had been swabbed for 66 bbl. of oil when it kicked off, flowed 19 bbl. of oil in 45 minutes, then died.

Gulf's 421-E Goldsmith, Ellenburger test in the Goldsmith field of northwestern Ector County, was said to be a failure in that formation, and operators may plug back and try for a completion in the Devonian. On a 1-hour drill-stem test at 9,685-9,730 ft., it recovered 1,890 ft. of sulfur water, with no shows of oil or gas. Top of the Ellenburger was reported at 9,686 ft., or 6,574 ft. subsea. Shows in the Devonian were at 7,981-8,040 ft.

A further extension of Wheeler field across the line into Ector County was made last week at Phillips Petroleum Co. 1 Cushing, Section 14, Block 46, T&P Survey, and a south offset to Phillips 1-G TXL, a completed dual producer from the Devonian and Ellenburger formations. The 1 Cushing flowed 283 bbl. of oil, cutting 15 per cent water, in 13 hours, from perforations at 8,435-8,535 ft.

In Winkler County, Sinclair Prairie Oil Co. 12-A J. B. Walton, on the northwest side of the Keystone multiple-pay field, and a northeast offset to Humble Oil & Refining Co. 1-E Walton, Silurian discovery for the area, promised an extension to Silurian pay. On a drill-stem test at 8,020-8,135 ft. gas came to the surface in 24 minutes and the recovery was 30 ft. of free oil, plus 270 ft. of oil and gas-cut mud. A second test, at 8,131-8,235 ft., open 1½ hours, recovered 310 ft. of gas-cut mud and 300 ft. of oil and gas-cut mud. Previously, this test was said to have made the largest showing for a Devonian producer of any well in the field. Results of a drill-stem test made in that formation at 7,505-7,615 ft. were not disclosed.

In northeastern Crockett County, Stanolind Oil & Gas Co. 1-TT University was scheduled for a 10,000-gal. acid treatment when the flow died after making 133 bbl. of 48°-gravity distillate and 10 bbl. of acid water in 24 hours. This flow was made after two treatments of 1,500 gal. and 5,000 gal. at 8,100-48 ft. Operators then swabbed 19 bbl. of dark, green oil in 12 hours. Gas flow was down from an estimated 10,000,000 cu. ft. to 21,437 cu. ft. daily. Total depth was 9,000 ft., plugged back to 8,250 ft.

Cities Service Oil Co. 1 Riley, western Gaines County prospect, located some 15 miles west and south of Seminole, was to get a third shot of acid in open hole at 7,040-7,251 ft. Treatments of 1,000 and 4,000 gal. of acid resulted in a 5-hour flow, putting 18 bbl. of oil into tanks. Operators were swabbing down while waiting for acid.

Humble Oil & Refining Co.'s Midland County test, 1 Floyd, in Section 16, Block 37, T&P Survey, ran a drill-stem test at 10,215-256 ft. Gas came to the surface in 9 minutes, and the flow was estimated at 25,000 cu. ft. daily. Only recovery was an undisclosed amount of gas-cut mud. Operators were drilling ahead below 10,276 ft. in limestone and chert.

WEST TEXAS SUCCESSFUL WILDCATS

Crockett County: Gulf Producing Co. 1 University "R," Sec. 14, Blk. 29, University Lands, 5½ mi. SE Clara Couch field, pumped and flowed 148 bbl. 32.4°-gravity oil in 16 hours, Grayburg 1,622 ft., TD 1,677 ft.

Moore Exploration Co. 1-4 A. C. Hoover "C," Sec. 4, Blk. FF, A. C. Hoover Sur., 1 mi. S of Shannon field, flowed 35 bbl. 31°-gravity oil, San Andres 2,394 ft., TD 2,433 ft.

WEST TEXAS WILDCAT FAILURE

Pecos County: W. H. Gilmore 1 M. H. Steiner-Shell, Sec. 6, Blk. 10, H&GN

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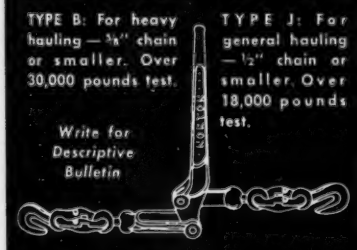

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Sur., 1½ mi. SW Pecos Valley pool, dry, TD 1,574 ft.

SOUTHEASTERN NEW MEXICO

HOBBS.—The Texas Co. 1 Garrett, 22-16s-38e, Lea County wildcat, plugged back from 5,790 ft. to 5,690 ft. and after a second acid treatment swabbed 49 bbl. of oil in 8 hours. J. W. Sorrels 1 Sorrels, 27-22s-34e, set 7-in. casing at 2,065 ft. and was drilling below 2,275 ft. in sand.

In Eddy County, Richfield Oil Corp. 1 Lake McMillan, 35-20s-26e, was drilling below 5,555 ft. in limestone and shale. E. Orcutt 2 Kepple, 19-17s-27e, had total depth at 1,903 ft., plugged back to 1,815 ft., and after cleaning out to 1,792 ft. the hole filled 1,600 ft. with oil. Production tests were to be made.

NEW MEXICO WILDCAT FAILURE

Chaves County: Richfield Oil Corp. 1 Comanche Unit, NE SE 13-11s-26e, dry, TD 6,129 ft., Glorietta 2,090 ft., Pennsylvanian 5,340 ft., Ellenburger 6,003 ft., granite wash 6,119 ft., pre-Cambrian 6,126 ft., elev. 3,609 ft.

MICHIGAN

Operations Begin To Pick Up

SAGINAW.—Michigan oil and gas operators listed 15 locations for new drilling in 11 counties in the past week while reporting 11 completions for 3 oil producers and 8 dry holes, 6 of which were wildcats. New wells were a 250-bbl. producer in Fillmore-Allegan, a 30-bbl. well in Kawkawlin-Bay, and a 20-bbl. completion in Mills of Ogemaw County. Except for the E. V. Hillard dry hole at 4,056 ft. in Franklin Township, Clare County, the wildcat failures were all shallow. New locations include two each in Allegan, Bay, Genesee and Newaygo counties, one each in Montcalm, Ottawa, Isabella, Mecosta, Missaukee, Ogemaw and Kent.

MICHIGAN WILDCAT FAILURES

Clare County, Franklin Township: E. V. Hilliard 1 Douglass-Hilliard, NE SW SE 24-20n-3w, dry in Dundee, TD 4,056 ft.

Kent County, Byron Township: Rex Oil & Gas Co. 1 Bruursma, NW SE SW 32-5n-12w, dry in Traverse, TD 1,719 ft.

Montcalm County, Sidney Township: Cities Service Oil Co. 1 Nelson, NW SE SW 3-10n-7w, dry, TD 1,375 ft.

Winfield Township: Sun Oil Co. 1 Mills, SW 25-12n-9w, dry, TD 1,218 ft.

Osceola County, Osceola Township: Ashby Drilling Co. 1 Foster, SW NE NE 12-18n-8w, dry, TD 1,605 ft.

Ottawa County, Jamestown Township: A. J. Boeve-W. D. Gannett 1 Ocobock, NE SW NW 22-5n-13w, dry in Traverse, TD 1,768 ft.

TEXAS GULF COAST

Deep Pay Proved for Colorado County Field

HOUSTON.—Deep production on the west side of Altair field of Colorado County has been proved by Superior Oil Co. 2 Joe W. Stafford et al. Located in the Puerta Tierra Irrigation Co. Survey, Abstract 668, the hole was bottomed at 10,304 ft., and 7-in. pipe cemented to 10,135 ft. The 2½-in. tubing was set on packer at 10,062 ft. On latest gage the well flowed 96 bbl. of 48°-gravity condensate daily through a ¼-in. choke with 2,602,000 cu. ft. of gas, ratio 30,200. Flowing pressure on the tubing 1,850 lb. Ten per cent mud and a slight amount of water were shown. Superior has located a deep north outpost on the east side of Altair production now, and roads are being built to location. It is the 6-A Mrs. Mathilda Tait, located in the Patrick O'Daugherty Survey, Abstract 167, and is projected to the 11,000-ft. level using company tools.

A new gas-condensate discovery for Refugio County was indicated in a drill-stem test made at 6,766-73 ft. in Hewit & Dougherty 1-A Kathleen D. Roache, wildcat about 4 miles southwest of Woodsboro. Test developed 750-lb. working pressure in 10 minutes through a ¼-in. choke top and botton, and recovered 60 ft. of condensate at that depth. Operators are now coring below 6,783 ft. in search of possible oil production. Located in D. J. Mitchell Survey, this test is approximately 3¾ miles northwest of La Rosa field.

New production from the Wilcox was indicated in Mac Drilling Co. 1 Cynthia Payne, wildcat test 4 miles south of Evergreen townsite in San Jacinto County, when 12 stands of oil and gas were recovered on drill-stem test made in the Wilcox sands from 7,688-7,700 ft. Using ⅜-in. bottom choke and 3/16-in. choke at top, and 3,500 ft. of water cushion, it started flowing with 1,600-lb. bottom-hole pressure which built up to 2,000 lb. in 20 minutes and 3,100 lb. when closed in. Tool was pulled, and a recovery of 12 stands of oil and gas with rat-hole mud was made. No salt water was shown. Log has been run, and at present operators are waiting on further orders. The test is located in the Vital Flores Survey, Abstract 14, and is 5 miles west-southwest of Coldspring field Cockfield and Wilcox production.

Twenty-seven new locations reported included six wildcats, two in Live Oak and one each in Brazoria, Calhoun, Fort Bend, and Liberty counties. The six wildcats completed were dry—two in Fayette and one

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each in Brazoria, Harris, Jefferson, and Refugio counties.

TEXAS GULF COAST WILDCAT FAILURES

Brazoria County: McCarthy Oil & Gas Corp. 1 Mrs. Ella M. Corbett, in Wm. Roberts Sur., in Blue Lake area, dry, TD 11,738 ft.

Fayette County: Clark & Cowden Drilling Corp. 1 Oswald Buescher, in Samuel Millet Sur., dry, TD 2,517 ft.

Cockburn Oil Corp. 1 Bruno Gebhard, in Wm. H. Jack League, 2 mi. S of Roundtop, dry, TD 6,508 ft.

Harris County: Texas Co. 2 Bender Estate, in T. W. Marshall Sur., Humble east flank, dry, TD 13,728 ft.

Jefferson County: McCarthy Oil & Gas Corp. 1-A Ed F. Lohmann et al in P. W. Farr Sur., Sec. 72, 2 mi. N of NW Hamshire discovery area, dry, TD 10,458 ft.

Refugio County: Continental Oil Co. 2 Jas. F. Welder Hrs., in Jas. Powers and Jas. Hewitson Sur., 8½ mi. N of Greta, dry, TD 6,625 ft.

ROCKY MOUNTAIN

Important Wildcats Slated To Be Drilled This Year

DENVER.—Most of the major companies operating in the Rocky Mountain area are making up their budgets on wells to be drilled in the second quarter of 1947. These are expected to include appropriations for a number of important wildcats. The wildcat program for the year, however, seldom gets into full swing until the third and fourth quarters due to high altitudes and weather conditions in the area. The number of wells is expected to exceed the record in 1946. At least six 10,000-ft. holes are included in the program.

Locations for wildcats generally are not released until drilling has been approved and operations commenced. Indications, however, are that three and possibly five will be drilled in southeastern Colorado, two or three in the San Juan basin, southwestern part of the state, and one or two near the western boundary south of the Rangely field. One to be drilled by Carter Oil Co. north of Craig, in Moffat County, has spudded. Local highs on the flanks of the Uncompahgre uplift in western Colorado are included in the tentative program, and a Pennsylvanian test in northeastern Colorado in an area where the Dakota sands have heretofore been the objective is probable. Wyoming wildcats probably will include a 12,000-ft. test in Sublette County in the Green River basin, two more deep wells on the Church Buttes structure, Uinta and Sweetwater counties where two are now drilling, and another 60 miles northeast of Rock Springs, another 4 miles west of the Quealy field in Albany County, another near the boundary of Natrona and Carbon counties, and two or three on the eastern rim of the Big Horn Basin.

South Baggs.—Kerr-McGee-Phillips Petroleum Co. 1 Unit, SE SE 10-12n-92w, Carbon County, Wyoming, stopped drilling at 9,512 ft., and is plugging back to test upper shows. Plug was set at 4,226 ft., and show of oil and gas in the base of the Fort Union will be tested. On a drill-stem test on the way down there was a recovery of 125 ft. of oil and gas-cut mud in 1½ hours at 3,930-55 ft. One of the best shows was at 3,771-81 ft., where 3,474,000 cu. ft. of gas, 50 ft. of oil, and no water were recovered in 24 minutes through drill pipe. Top of the Mancos shale was at 9,265 ft. Several shows of oil and gas were recovered in the Tertiary beds.

Cat Creek.—Ralph Chamberlin 12-A Rhens, NE NE SE 9-15n-29w, West Dome on the Cat Creek anticline, Petroleum County, Montana, an old well deepened

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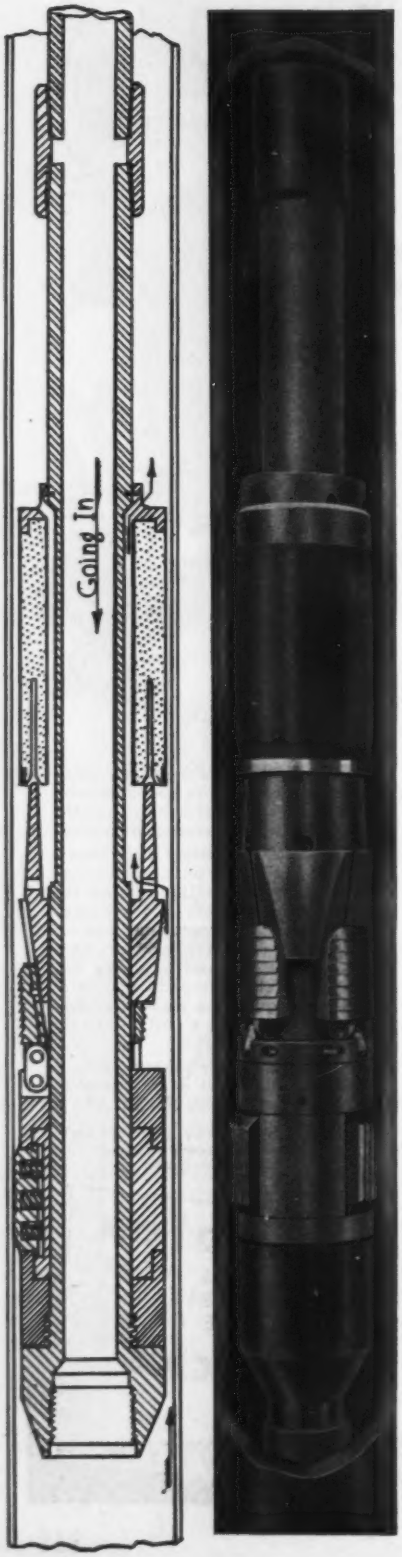

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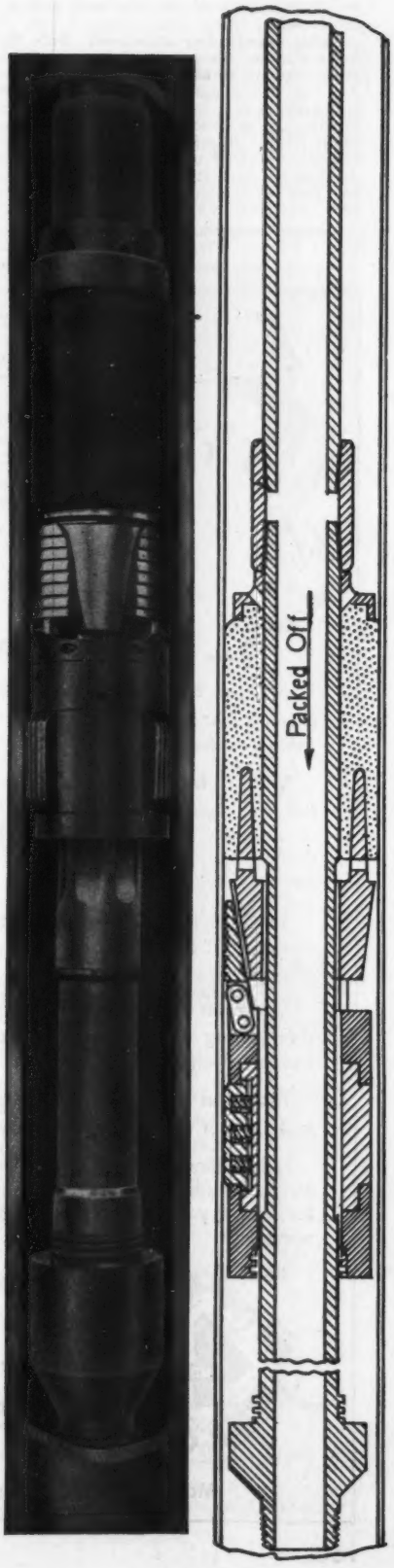

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from 1,420 ft. a year ago following the discovery of the oil below the Cat Creek sands on the Mosby Dome, 6 miles southeast, had some small production with water in the Morrison sand at 1,753 ft., total depth. This sand was squeezed off and hole deepened to the Ellis sand at 1,876 ft. and encountered water. It will be plugged back to the Morrison and recompleted.

Union County test abandoned.—Pure Oil Co. 1 Wiggins, NE NE SE 13-31n-36e, Black Mesa District, Union County, New Mexico, was reported abandoned in granite at 3,540 ft. Location is 5 miles south of the Baca County line in Colorado, and 35 miles due south of the Sharples-Huber tests in the Freezeout district which are exploring the possibilities of a stratigraphic trap on the east flank of the Las Animas-Sierre Grande arch. Elevation, 4,373 ft.

Rangely outposts.—Stanolind Oil & Gas Co. 1 Pepper, SW SE NW 31-2n-101w, 2 miles east of nearest producer, Rangely field, had top of the Weber at 6,075 ft. (—838) and is bottomed at 6,377 ft. A drill-stem test a 6,310-77 ft. yielded 70 stands of salt water in 4 hours. Same company's 2 A. C. McLaughlin, C SE NE 5-1n-102w, outpost on the south, one location from a producer, had the Weber at 5,886 ft., and at 6,366 ft. flowed 1 bbl. of oil per hour for 2 hours and then went dead. Rotary tools are being moved back in.

Hidden Dome discovery.—Ohio Oil Co. 2 OPC-2, NW SE SE 31-38n-90w, a discovery in the Tensleep, is nearing completion as a flowing well, reported making 15 bbl. an hour at 4,725 ft., total depth. It is still testing. Top of Tensleep was at 4,549 ft., where 7-in. was set. It also had saturation in the Embar on the way down. Top of Embar was 4,241 ft. The field is on the east side of the Big Horn Basin. It has some light oil production in the Frontier and formerly produced gas in that formation.

New operations.—Nine new operations were reported, of which one was in the Rangely field in Colorado, one each in Byron, Mush Creek, Worland and Herrick fields in Wyoming, two in Cut Bank and one each in Cat Creek and Kevin-Sunburst in Montana. One of the Wyoming locations is Superior Oil Co. 2 Herrick, SE SW SW 1-16n-76w, Herrick Dome, Albany County, ½ mile southwest of the Tensleep discovery which is making 315 bbl. per day. Another is Pure Oil Co. 6 Unit, NE NE NW 19-48-92w, Worland Dome, ¾ mile southwest of No. 3, the best of the three producers completed, and on the southeast trend from the top. A Montana location is R. C. Tarrant 1 Butler, NW NW SE 21-15n-30e, Mosby Dome, Cat Creek field, which is to be deepened from the Brindley sand to the Ellis. It was drilled to 1,338 ft. 2 years ago by V. M. Kirk and completed for 80 bbl. in the Brindley sand, but subsequently went dry.

Completions.—Nine wells were completed, of which six were oil wells for 884 bbl. initial production, two were gas wells and one was a dry hole. Four oil wells for 766 bbl. were in Rangely field in Colorado, one for 70 bbl. in Hamilton field in Wyoming, and one for 48 bbl. in Cat Creek in Montana. One gas well was completed in the Bowdoin field in Montana, and one in Fulcher Basin, northwest New Mexico. The dry hole was in Cut Bank.

MONTANA WILDCAT FAILURE

Cut Bank, Pondera County: A. B. Cobb 2 Security Bank, NW NE NE 1-31n-6w, TD 3,305 ft., Madison 3,279 ft., sulfur water, show of oil at 3,110 ft., plugged and abd.

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LA.-ARK.

Carter's Fouke Field Test Flows Gas and Distillate

SHREVEPORT.—Carter Oil Co.'s gas-distillate discovery on the northwest side of Fouke field, Miller County, flowed gas and a small amount of distillate from the Kilpatric limestone. With total depth at 7,505 ft., in Cotton Valley, plug was reset at 4,980 ft. and perforations made from 4,940-44 ft. and 4,948-54 ft. On a drill-stem test gas flowed at the rate of 1,500,000 cu. ft. a day with a flowing pressure of 1,100 lb., which rose to 1,800 lb. when shut in. Recovery was 120 ft. of straw-colored distillate and 180 ft. of wash water. Operators were to acidize the section before further tests are made.

In Union County, McAlester Fuel Co. 1-A Patterson, 19-18s-14w, had total depth in Smackover but found no shows. Perforations in the Travis Peak from 3,538-46 ft. recovered salt water with no shows. Electric log tops, on an elevation of 215 ft., were: Tuscaloosa 2,900 ft., Lower Glen Rose 3,070 ft., Travis Peak 3,452 ft., Cotton Valley 4,900 ft., and Smackover 7,260 ft. Plymouth Oil Co.'s 1 Trammell,, 7-18s-12w, had total depth at 6,391 ft. in Smackover and was testing higher up the hole. Perforations at 2,295-3,305 ft., in Nacatoch sand, returned a showing of oil.

In DeSoto Parish, Skelly Oil Co. 1 Nash, 20-12n-16w, was drilling below 3,240 ft. in Paluxy shale. The test found gas shows starting in a fine, white sand at 2,925 ft., in the Austin, and a drill-stem test from 2,850-3,046 ft., open 1 hour, brought gas to the surface in 6 minutes, with a maximum surface pressure of 835 lb. Recovery was 390 ft. of gas-cut mud, with no estimate made on the flow of gas. Flowing bottom-hole pressure was 1,235 lb., which increased to 1,410 lb. shut in. Gas was said to be coming from a sand in the Paluxy at 2,922-28 ft.

In Webster Parish, Cotton Valley Operators' deep test, the 2 Oliphant-Banks, 34-21n-10w, had total depth at 1,467 ft. in salt, and was conditioning the hole to deepen. In Winn Parish, Stanolind Oil & Gas Co.

1 Tremont, 30-12n-1w, was drilling below 8,556 ft. in anhydrite and shale.

NORTH LOUISIANA WILDCAT FAILURE

DeSoto Parish: Rogers Lacy 1 Pace, SE NW 28-13n-16w, dry, TD 6,648 ft., no tops reported.

MISSISSIPPI

Gulf Oil's 1 Rowland Continues Testing

JACKSON.—In Amite County, Gulf Oil Corp. 1 Rowland, 39-4n-2e, perforated at 11,469-76 ft., set packer at 11,432 ft., and on drill-stem test recovered 2,392 ft. of water cushion, 8,102 ft. of salt water, and 920 ft. of mud cut with salt water and gas. Operators squeezed and made new perforations at 11,349-53 ft. to continue testing.

Gulf's 1 Major, 29-6n-11w, Jones County test, was reaming hole at 9,020 ft., total depth, in red shale. Electric log ran to 9,021 ft. showed base of the Marine Tuscaloosa at 8,432 ft., Massive anhydrite 8,725 ft., Comanchean 8,894 ft., and the first sand at 8,913 ft.

In Wayne County, Humble Oil & Refining Co.'s deep test, the 2-B G. M. & O. Land Co., 24-9n-8w, was drilling in sandy shale and lime below 11,165 ft. In Marion County, Humble's 1 Tullos, 12-1n-18w, was drilling below 6,575 ft. in shale after a drill-stem test recovered 514 ft. of water cushion, 180 ft. of mud, and 5,021 ft. of salt water. Packer had been set at 5,789 ft.

MISSISSIPPI WILDCAT FAILURE

Smith County: Woodley Petroleum 1 Womac-Butler, SW NW SW 36-1n-6e, dry, TD 9,503 ft., side-wall cores 9,239-42 ft., green sand with a slight show of oil.

FLORIDA WILDCAT FAILURE

Flagler County: Humble Oil & Refining Co. 1 J. W. Campbell, C SE SW 8-11s-28e, dry, TD 4,633 ft.

CALIFORNIA

Leasing Plays Picking Up in Coastal District

LOS ANGELES.—Another big wildcat play is getting under way in the Coastal district. Several independent companies have joined in leasing 11,000 acres in northern San Luis Obispo and southern Monterey counties. Location has been staked for the first test well in 2-25s-12e, which falls in San Luis Obispo County about 5 miles northeast of the town of San Miguel. Acreage comprises Sections 21 and 22, and 26 to 36, inclusive, in Township 24s-12e, Monterey County, and Sections 1 to 12, inclusive, in Township 25s-12e, San Luis Obispo County. Participating companies are Oceanic Oil Co., Bankline Oil Co., Barnsdall Oil Co., Occidental Petroleum Co., and E. B. Hall & Co. The latter concern will act as operator.

Two other big plays in the Coastal district were announced recently. Union Oil Co. has leased 7,000 acres on the Rancho Nipomo, north of the Santa Maria field in San Luis Obispo County, where a prospect well will be spudded within 60 days. Sunray Oil Corp. and W. W. Porter have leased 5,000 acres east of the Orcutt field in Santa Barbara County. Their first test well will spud next month.

Pacific Western Oil Corp. has had more bad luck in preparing its Kern County wildcat, 1 National Royalties, California's deepest well, for production tests. Drill pipe stuck at 16,354 ft. while drilling out cement, after setting 5½-in. casing at 16,406 ft. Preparations are under way to make an inside cut at 16,000 ft. After the pipe is removed tests will be made through perforations. Temperature is so high in the lower part of the hole (430° F.) that a special powder will be used in the perforating bullets to prevent premature firing. Persistent efforts covering a period of months to put this hole in shape for testing lend color to reports that encouraging showings were obtained during the later stage of the drilling operation.

The Standard of California crews which drilled Middle Dome Corp.'s 73-30V Eocene discovery well are on vacation so remedial work to exclude water is temporarily at a standstill. The well is currently flowing 92 bbl. of 39.5° oil, 33 per cent cut, through an 18/64-in. choke.

Production has been extended about 1,000 ft. northwest in the Trico gas field in Kings County by the completion of Pacific Western Oil Corp. 1 Taylor in 36-23s-22e. The well flowed 3,600,000 cu. ft. through a ½-in. choke and was shut in. Southeast of this completion, on 8-24s-23e, Shell has made location for 1 Riverside-Bent-Mitchell.

In Los Angeles County, Richfield Oil Corp. was engaged in production tests in 4 Union Pacific unit in the East Los Angeles field. Recovery indicated that a good producer of clean oil is in prospect.

New locations last week soared to 63, 33 more than in the preceding week, when Union Pacific Railroad Co. announced locations for 23 new wells in the Wilmington field.

CALIFORNIA WILDCAT FAILURES

Los Angeles County, Montebello area: Barnsdall Oil Co. 1 Cipes, 7-2s-11w, dry, TD 7,224 ft.

La Mirada area: General Petroleum Corp. 46-1 La Mirada Community, 16-3s-11w, dry, TD 12,629 ft.

Devils Canyon area: Universal Cons. Oil

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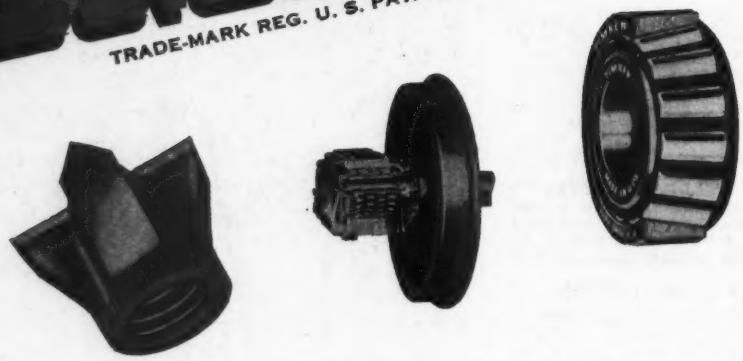

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CANTON 6, OHIO

Co. 1 Devils Canyon, 27-5n-17w, dry, TD 7,657 ft.

Santa Barbara County, Lompoc area: Union Oil Co. 47 Purisima, 10-7n-34w, dry, TD 3,405 ft.

Kern County, Sheep Springs area: Independent Exploration Co. 14 Woods, 16-29s-21e, dry, TD 5,371 ft.

Tejon Ranch area: Richfield Oil Corp. B-1 Tejon, 28-11n-18w, dry, TD 1,613 ft.

Williams anticline area: Signal Oil & Gas Co. 1 Honolulu-Carpenter, 6-28s-15e, dry, TD 4,344 ft.

OHIO, KENTUCKY

East Clayton Field Producer Brought In

COLUMBUS.—Quaker State 2 James Adrian, Section 10, Clayton Township, Perry County, filled up 1,000 ft. in 10 hours after drilling in and after an 80-qt. shot flowed 42 bbl. the first day. The producer is on the extreme east edge of the Clayton field, and should encourage more drilling east and southeast. Clinton sand came in at 3,410-36 ft.

In Reading Township, Perry County, John Morrow et al drilled in the 3 Alice Cleary, Section 18, with 475,000 cu. ft. natural. Clinton sand at 2,779-2,807 ft. was shot and gaged 700,000 cu. ft. when shut in. The well is a west extension to the small gas pool now being drilled southwest of Somerset.

Atha Realty completed a small gas well southeast of the old Fultonham pool, in 1 Miles Hoover, Section 24, Newton Township, Muskingum County. Clinton at 3,362-3,437 ft. gaged 213,000 cu. ft. natural and 450,000 cu. ft. after shot.

Willits & Stout are drilling a wildcat on E. G. Fuller, Lot 35, Bennington Township, Morrow County. The test is about 15 miles west of the Clinton sand fields.

Hoey et al are moving in a rig to drill a second wildcat in Solon Township, Cuyahoga County. The test is located on Emma Glover in Lot 7.

Of the 22 locations reported for the week, 5 were in Perry County, 3 in Ashland, 3 in Muskingum, and the rest in 8 scattered counties. Completions were down to 14.

OHIO WILDCAT FAILURE

Holmes County, Paint Township: Ohio Fuel Gas 1 Y. J. Miller, Lot 7, Clinton 4,127-4,229 ft., TD 4,285 ft.

EASTERN KENTUCKY

ASHLAND.—Knott and Magoffin counties were noted in the completion list during the week, with the former getting in two.

Kentucky-West Virginia Gas Co. completed Well No. 5,686, G. J. Short property in Knott County, 3,405 ft., 103,000 cu ft. in shale, after shot; Well No. 5,688, A. J. Kelly property, Knott County, 3,198 ft., 163,000 cu. ft. in shale, after shot; and Well No. 5,697, Green Patrick property, Magoffin County, 2,669 ft., 127,000 cu. ft., Corniferous.

New locations were noted on the Grover Runyon property, Pike County; H. H. Smith et al, Knott County; Robert Williams, Pike; Grant Green, Magoffin; Matilda Clark, Pike; William Hyden, Johnson; Adam Crum, Martin; Harrison Hall, Knott; and Joseph Stewart, Knott.

WESTERN KENTUCKY

OWENSBORO.—Keen interest has been aroused by reports from a wildcat in extreme southeastern Kentucky, Pure Oil-Stanolind Oil & Gas Co. 1 Hammons, 2-H-67, Clay County, near Manchester, which is swabbing 40° oil from the Knox dolomite. Well was drilled to 3,640 ft. total depth, after topping Knox at 3,420 ft., plugged back to 3,500 ft., set 7-in. at 3,471 ft., drilled out plug and started a slow fill up with oil.

INDIANA

EVANSVILLE.—There were no wildcat completions during the current week, development work being confined to eight field tests, six oil wells, one gas well and one dry hole.

John Savage 1 Hall, SE SE SW 19-1s-10w, a Gibson County wildcat, recovered 25 ft. of oil-cut mud on a drill-stem test at 1,900-19 ft. Cypress was logged at 1,667-75 ft. and McClosky at 1,911-15 ft. Pipe has been set 11 ft. above the McClosky lime. Total depth is 1,919 ft.

Sam Malis 1 Fleener, NE SW SW 22-3s-12w, Gibson County, a wildcat drilled to 2,735 ft. is cleaning out to test the McClosky after perforating pipe at 2,648-54 ft. and 2,682-88 ft.

KANSAS

New Gas Field For Chase County

THREE miles east of the Chase pool and about 5 miles west of the Lyons gas pool, Drillers Gas 1 Lowery, C SE SW 36-19s-9w, is a 7,000,000 cu. ft. gas well in the Tarkio lime topped at 2,117 ft. Well was drilled to 2,200 ft. Pipe was set at 2,193 ft. and perforated from 2,117 to 2,127 ft.

Branine & Holl 1 Sullivan, SW SW SW 4-21s-6w, Rice County, located on the west flank of the Welch pool is a 200-bbl. pumper in the Mississippi found at 3,449-75 ft.

Harbar Drilling Co. have reopened 1 Baldwin, C N½ NE SE 9-10s-19w, Rooks County. The hole was cleaned out to the

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top of the Arbuckle at 3,727 ft. where 5-in. pipe has been set. The old total depth was 3,771 ft. This test was originally drilled by Lario Oil & Gas and Phil Polhamus and abandoned prior to the opening of the Vohs pool, in June 1945, 2 miles to the east. The Vohs pool produces from both the Lansing and Arbuckle.

KANSAS SUCCESSFUL WILDCAT

Pawnee County: Cities Service 1 Becker, NE SE NW 32-23s-15w, open flow of 12,800,000 cu. ft. gas from Arbuckle at 4,048-4,142 ft.; Kansas City 3,582 ft., Viola 3,910 ft., shale 3,993 ft., TD 4,175 ft.

KANSAS UNSUCCESSFUL WILDCATS

Barton County: Lion Oil Co. 1 Merten, SW SW NW 12-20s-14w, dry, TD 3,588 ft., Topeka 2,906 ft., Lansing-Kansas City 3,218 ft., conglomerate 3,453 ft., Arbuckle 3,491 ft.

Butler County: Clark & Ives 1 Phillips, SE SE NW 16-29s-7e, dry, TD 1,165 ft., no tops reported.

Ellis County: H. H. & B. Drilling 1 Blender, NW NW NW 20-12s-18w, dry, TD 3,913 ft., Kansas City 3,490 ft., conglomerate 3,772 ft., Arbuckle 3,904 ft.

Greenwood County: Chas. Gleason et al 1 Marks, SW NE NE 12-28s-8e, dry, TD 2,646 ft., Mississippi lime 2,635 ft.

Kiowa County: Stanolind 1 Sealey, NW NW NW 25-30s-18w, dry, TD 5,794 ft., Kansas City 4,415 ft., Mississippi lime 5,070 ft., Misener 5,380 ft., Viola 5,384 ft., Arbuckle 5,735 ft.

Marion County: Mallard Drilling 1 Peters Est., SE SE NE 4-20s-1e, dry, TD 3,273 ft., Kansas City 2,174 ft., Mississippi lime 2,779 ft., Viola 3,187 ft.

Saline County: W. K. Page and Jackson 1 Lunden, SW SW NE 33-14s-2w, dry, TD 3,340 ft., Mississippi lime 2,660 ft., Viola 3,266 ft.

OKLAHOMA

McClain County Test Flows 100 Bbl. Per Hour

THE C. L. Carlock 1 Harrison, NE NW SE 25-5n-4w, McClain County, after flowing 100 bbl. per hour for 4 hours through a ¾-in. choke with 1,800 cu. ft. gas-oil ratio, was put on a ½-in. choke for a second 4-hour test, and flowed 51 bbl. per hour, gas-oil ratio reduced to 1,500 cu. ft. On a third 4-hour test, with choke reduced to ⅜-in., it flowed 27 bbl. per hour, with gas-oil ratio cut down to 1,200 cu. ft. Production is from the Bromide.

Stanolind Oil & Gas Co. 1 Briscoe, C NW SE 4-4n-5w, Grady County, is drilling below 9,590 ft. after coring highly saturated sand at 9,563-65 ft.

Dearing, Inc., 1 Rogers estate, NE NW SE 32-4n-2w, Garvin County, total depth 7,000 ft., set 5½-in. pipe at 6,996 ft. and has collapsed section near end of the string. A drill-stem test at 6,234-48 ft., recovered 5 ft. of 41°-gravity oil and 135 ft. of heavily oil-cut mud.

Sinclair Prairie 1 Garrett, NW SW SE 13-5n-2w, McClain County, drilled to 7,970 ft., had Hunton at 6,734 ft., and Bromide at 7,420 ft. The well was plugged back to 6,844 ft., perforated at 6,730-90 ft., acidized with 5,000 gal. and flowed 160 bbl. in 19 hours through ¾-in. choke.

McElreath & Suggett 1 Tolbert, SE SW NW 14-3n-1w, Garvin County, a wildcat test about 1 mile west of the East Antioch pool, drilled to 4,335 ft., found the Bromide at 4,183 ft. and the McLish at 4,238 ft. Pipe was perforated from 4,140-52 ft. After 1,000 gal. of acid the well pumped 6 to 8 bbl. of 40° oil per day. Operators may perforate upper sand.

Gutowsky Brothers-Philco Drilling Co. 1 Pelter, C NE SE 21-25n-12w, Alfalfa County, recovered 70 ft. of gas-cut mud with show of oil on a drill-stem test at 6,045-78 ft., 5 to 8 ft. in Mississippi lime, and is now drilling below 6,688 ft.

R. Olsen Oil Co. et al 1 Ott, C W½ SW SE 4-21n-9w, gas-distillate discovery of the Southeast Meno pool, Major County, has been connected with Consolidated Gas Co. pipe line and is flowing 3,500,000 cu. ft. of gas per day plus some distillate and brackish water.

Magnolia 1 Hockett, NE SE NE 10-2n-8e, Coal County, had Hunton at 6,535 ft. and cored 10 ft. of saturated lime at 6,545-55 ft. Viola was topped at 7,007 ft. A core from 7,288-98 ft. recovered 2 ft. of sandy lime bleeding oil and 2½ ft. of dry sandy lime. Core is now being taken at 7,304 ft.

OKLAHOMA SUCCESSFUL WILDCATS

Cotton County: C. P. Burton 1 Pah Di, NE NE NE 24-3s-12w, pumped 175 bbl. of 37°-gravity oil per day from sand at 1,483-92 ft., TD 1,492 ft.

Akin-Dimock 1 Shaw, SE NW NE 28-3s-11w, pumped 70 bbl. of 35°-gravity oil per day from sand at 1,518-25 ft.; sand 1,272-92 ft., conglomerate 1,320-30 ft., sand 1,403-05 ft. with a show of oil, TD 1,525 ft.

J. W. Baldwin et al 1 Shaw, SW NE NE 28-3s-11w, produced 50 bbl. of 35°-gravity oil per day from 1,513-25 ft.; sand 1,501-07 ft., TD 1,527 ft.

Garvin County: Oil Carriers, Inc. 1 Martin, NE NE 1-4n-4w, flowed 374 bbl. of 42°-gravity oil per day from Chimney Hill at 8,585-8,720 ft., and from 9,060-9,100 ft.; Belle City 5,670 ft., Springer 7,330 ft., Mayes 8,250 ft., Hunton 8,600 ft., Sylvan 9,089 ft., Viola 9,299 ft., TD 10,320 ft.

OKLAHOMA WILDCAT FAILURES

Cotton County: Norman-Graham Drilling Co. 1 Graham, NW NW NW SW 5-4s-

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11w, dry, TD 2,534 ft., no tops reported.

Garfield County: Ace Gutowsky et al 1 Edwards, NE NE SE 19-20n-4w, dry, TD 4,860 ft., Layton 7,400 ft.

Lincoln County: Davon Oil Corp. 1 Walker, C SW NE 22-12n-6e, dry, TD 4,710 ft., Woodford 4,325 ft., Hunton 4,352 ft. with a show of oil, Sylvan 4,495 ft., Viola 4,565 ft., Bromide 4,605 ft.

Noble County: Stanolind 1 Sanders, SW SW SW 17-23n-1e, dry, TD 4,546 ft., Layton 3,345 ft., Mississippi lime 4,500 ft.

Tillman County: S. D. Johnson 1 Kinder, SE SE NW 30-1s-15w, dry, TD 1,606 ft.

H. W. Little et al 1 Morton, SW SW NE 17-4s-14w, dry, TD 2,509 ft., Granite Wash 2,259-66 ft. with a show of oil.

B. Thorpe 1 Sherry, SW NW SW 5-1n-19w, dry, TD 1,651 ft., Granite Wash 1,208-22 ft.

ILLINOIS

Wayne County Gets Two Wildcat Hits

MATTOON.—Fred Noah & Sons 1 Englebright, NW NE SW 18-1s-8e, Wayne County, swabbed 200 bbl. of oil, free of water, in 24 hours while cleaning out after a 30-qt. shot in the Aux Vases sand at 3,091-3,109 ft. Total depth is 3,114 ft. in the Geff pool.

J. W. Rudy 1 Hampton, SW NE NW 26-1s-5e, Wayne County, flowed gas in 12 minutes and clean oil in 30 minutes on a drill-stem test of the McClosky lime at 3,154-62 ft. Casing was set at 3,153 ft., total depth is 3,178 ft.

NuEnamel Corp. and Gilliam-Aspin 1 Adams, SW NW SE 10-6n-7e, Effingham County, 2 miles northeast of the Bible Grove pool, acidized the McClosky lime at 2,868-78 ft. with 1,000 gal. and pumped 233 bbl. of oil.

Joe Reznik et al 1 Valter, S½ SE NE 3-9s-9e, Gallatin County, a wildcat near North Junction pool, drilled to 2,742 ft. and plugged back to 2,739 ft., swabbed 14 bbl. of oil and 20 bbl. of water per day on test of Aux Vases, at 2,726-39 ft. The test may be drilled deeper.

ILLINOIS WILDCAT FAILURES

Clinton County: Benoist Brothers et al 1 Krebs, SW SE NW 26-2n-3w, dry, TD 1,286 ft., Paint Creek 1,148-60 ft., Benoist 1,245-80 ft.

Madison County: H. Hoffman 3-A Wilson, SE SE NE 24-4n-6w, dry, TD 2,460 ft., Benoist 1,118-42 ft., Ste. Genevieve 1,234 ft.

Saline County: Pure 1 "A" Tison, SW NE NE 26-7s-6e, dry, TD 3,182 ft.

Wabash County: Francis Beard 1 Marbus Community, NE NE SW 31-2n-13w, dry, TD 2,875 ft., Glen Dean 2,278 ft., Cypress 2,566-76 ft., Ste. Genevieve 2,783 ft., McClosky 2,861 ft.

White County: F. Hildt 1 Williams, SW NE SE 28-3s-10e, dry, TD 3,290 ft., Ste. Genevieve 3,152 ft., McClosky 3,259-63 ft.

ILLINOIS SUCCESSFUL WILDCATS

Effingham County: National Associated 1-A Jacobs, SE SW SW 24-6n-6e, TD 2,886 ft., IP 118 bbl., Aux Vases 2,668-78 ft., Ste. Genevieve 2,752 ft., McClosky 2,823-34 ft.

Wabash County: Illinois Mid-Cont. 1 Kurtz, NW NE SE 25-2s-14w, TD 2,874 ft., PB 2,103 ft., pumped 15 bbl. oil and 15 bbl. water, Tar Springs 2,096-2,118 ft., shot 20 qt. 2,090-2,103 ft.

Manufacture of Synthetic Gasoline in U. S.

(Continued from page 73)

problems. These are mainly problems that arise in the welding of aluminum plate in thicknesses greater than 1 in. A large part of the process equipment for the oxygen plant will be fabricated from 18-8 stainless.

The next step in the process, involving the partial combustion of the natural gas with oxygen, introduces some complex engineering problems. In this step, as previously pointed out, preheated methane and oxygen are mixed and react under pressures of about 300 psi. and 2,500° F. temperature. The selection of suitable refractory materials to withstand the extremely high temperatures in the prevailing atmosphere, the design of suitable mixing equipment for the methane and oxygen, and the provision of adequate protection against excessive temperatures in the vessel walls constitute some of the problems.

Present plans for the synthesis gas generators are that a boiler will be used as a means of cooling the synthesis gas. We believe that this will be the first application of a pressure-fired boiler operating at these conditions. The unit is being designed so that the heat-transfer surface is removable for maintenance. The

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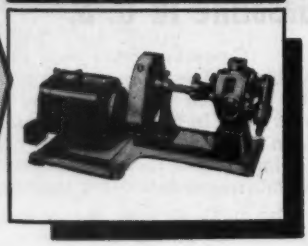

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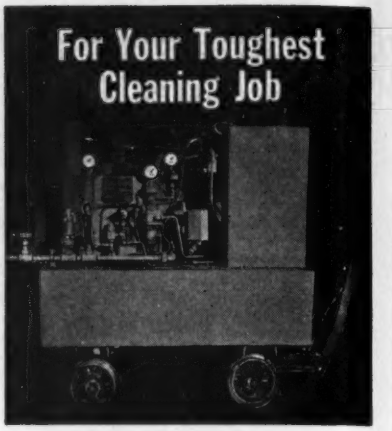

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steam-generating pressure will be approximately 650 psig. Water-cooled walls will be provided to maintain a safe metal temperature on the shell of the vessel.

As an indication of the improved technology over the German method of synthesis-gas manufacture wherein one water-gas set had gas generation capacity equivalent to a daily production of 115 bbl. of synthetic oil in the proposed equipment synthesis gas equivalent to 3,000 bbl. per day of oil is produced in one vessel of 2,000-cu.-ft. volume, which also contains cooling surface sufficient to remove waste heat. Thus, only two such vessels are expected to be required for a commercial synthetic gasoline plant of 6,000-bbl.-per-stream-day capacity.

Interesting Engineering Problems

The design of the synthesis converters also introduces a number of interesting engineering problems. These include the provision of adequate cooling surface within the reaction vessel without interference in the necessary turbulence of the fluidized catalyst particles, a selection of materials of construction to withstand the abrasive action of the catalyst at the prevailing conditions of pressure and temperature, and the design of suitable equipment for the separation of suspended catalyst particles from the product gases leaving the reactor. In one design it is contemplated that a vessel of approximately 3,400-cu.-ft. volume will have a capacity for production of 1,000 daily barrels of synthetic oil. This may be compared with the standard German reactor design in which 18 bbl. daily of synthetic oil were produced in a reactor of 950-cu.-ft. volume. Thus, in a commercial plant six reactors would be required to produce 6,000 bbl. per day of oil whereas by the German technique some 300 reactor units would be required. Approximately 350,000 lb. per hour of 650-lb. steam would be generated in the synthesis reactors.

Approximately 1 billion cubic feet per day of gas are handled through the reactor section of a 6,000 bbl. daily plant. Recycle compressors handle about 750,000,000 cu. ft. per day of this gas quantity. These are of the centrifugal type operating at 250 psig. suction pressure with a differential pressure of about 30 psig. Large quantities of heat (340 M.M. B.t.u./hr.) are transferred by gas to gas exchangers requiring a large amount of surface.

The fractionating and recovery equipment for the recovery and finishing of hydrocarbons and chemicals is largely conventional. The equipment for the catalytic polymerization unit does not present any particular problems that have not been previously solved.

The utility section of a synthetic gasoline plant is unusual only in size. The entire plant requires about 1,200,000 lb. per hour of steam at 600 psig. and 750° F. for normal operation. About two-thirds of this requirement can come from the process units mentioned above. Fired superheaters superheat the steam from the process generators. The cooling tower is also somewhat unusual because of its size; present designs require a water-circulating capacity of 135,000 g.p.m. with a 14° F. approach. The rest of the equipment for this section is of ordinary design.

It is apparent that partly through the utilization of a more economic raw material but predominantly through the application of improved engineering and technology the American synthetic gasoline process is much improved in efficiency and economics over the German technique. In the present application, premium synthetic gasoline of approximately 80 octane number may be produced in competition with natural petroleum products of equivalent quality, taking into consideration operating and amortization costs, with natural gas at prevailing prices. It is currently indicated that the investment for a synthetic oil plant is of the order of $3,000-$3,500 per daily barrel of hydrocarbon product, which is less than half the corresponding figure for the German plants.

At the present time plans are being considered for the installation of at least two synthetic oil plants in the United States. One is to be built by Carthage Hydrocol, Inc., at Brownsville, Tex. The other plant is one being contemplated by Stanolind Oil & Gas Co., probably to be located in the Hugoton gas field in Kansas. In addition to the synthetic-gasoline plants, major facilities at both locations are planned for the recovery and purification of byproducts chemicals.

A brief consideration is pertinent on the possible future applications of the synthetic gasoline process. It has been estimated by some of the more optimistic that within the next 15 to 20 years the daily production in the United States of synthetic hydrocarbons might be considerably over 200,000 bbl. daily. While interest at the present time is being devoted to the utilization of natural gas as a raw material, it must be recognized that the utilization of coal for this purpose in a variation of the present technique will become economically attractive as supplies of natural gas and petroleum products are depleted. Preliminary attention is already being devoted to the improvement of the engineering and technology involved in the mining and utilization of coal for this process, and further work will be done when economic conditions dictate. It may be predicted safely that adequate supplies of liquid fuels will be available for at least the next 1,000 years at reasonable cost through the synthesis of these materials from natural gas or coal.

Landing Mats Used

NEW ORLEANS, La.—More than 1,000,000 sq. ft. of surplus steel mats, used during the war by the military forces as landing mats for airfields, have been sold in recent months to oil-field supply firms, War Assets Administration officials here announced. The mats, they said, are linked together to form roads to oil wells.

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Among the Drilling Contractors

I. F. Scott will drill the Sohio Petroleum Co. 4 Orient Gas Unit, in C SW 13-17n-7w, Osceola County, Michigan.

Lee Drilling Co. is drilling contractor on the Carter Oil Co. 1 Helvey, in C SE NW 25-2n-2w, Garvin County, Oklahoma.

Arrow Drilling Co. has drilling contract on the Phillips Petroleum Co. 1 Curry, in southwest part of a 66-acre lease in the J. A. Malone Survey, Smith County, Texas, and was moving in.

Northern Development Co. of Edmonton, Alta., is completing L. & V. L. in SE LSD 10, 2-49-28w3 in the Saskatchewan end of the Lloydminster field and has contract for Lyons 3, SE LSD 7, 35-48-28w3 in the same field.

McClure Drilling Co. has been awarded contract to drill the Rex Oil & Gas Co. 1 James L. Brand, in NE NE SW 36-11n-6w, Montcalm County, Michigan.

L. E. Mong has drilling contract on the J. B. Levan et al 1 Russell, wildcat in SW NW NE 3-4s-10w, Tishomingo County, Mississippi, southwest of Iuka. Contractor was moving in.

J. O. Tilley Drilling Co. was moving in to start contract on the R. W. Brown 1 Bailey, in NE SW NE 2-12n-5e, Lincoln County, Oklahoma. Location for the 3,200-ft. or Prue zone test is near the Wilzetta townsite and on the flank of the Wilzetta field.

Waldron Drilling Co. has been awarded contract on the B. E. Ried 1 McCartney, in 26-10n-1w, Winn Parish, Louisiana. Location for the wildcat test is 5 miles northwest of Rochelle.

Kerr-McGee Oil Co. has been awarded drilling contract on the Carter Oil Co. 1 Bradshaw, in C NW SE 4-4n-3w, Garvin County, Oklahoma.

Warren Gann has the rotary contract, and **Norman Butler** the cable-tool contract on the G. F. Aldrich 1 Shell-Mueller, 2,500-ft. contract in North Pecos County, Texas, 3½ miles east of the Shearer field. It will test for pay in the San Andres-Permian. The project will start with rotary and finish with cable tools.

E. M. Shields has drilling contract on the Socony-Vacuum Oil Co., Inc., 3 Forrest & Christie Comm., in SW NW SW 36-9n-11w, Kent County, Michigan.

Wharton Drilling Co. has contract on the Sun Oil Co. 1 Alford, wildcat in NW NE 3-9n-6w, Macoupin County, Illinois, which was drilling below 1,100 ft.

Big Chief Drilling Co. and **Sohio Petroleum Corp.** have staked location for their 1 Parker-G, in Lot 107, J. P. Evans subdivision of 36-6n-2w, LaGrange field, Adams County, Mississippi. Big Chief and Skelly Oil Co. are planning a new test on the northwest flank of the Wayne pool of Mc-

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are SELF-ADJUSTING FOR WEAR

GATHERING PUMPS
REFINERY PUMPS
BULK STATION AND TRUCK PUMPS
HAND PUMPS
SUCTION LINE STRAINERS

Capacities to 750 GPM.

Pressures to 300 psi.

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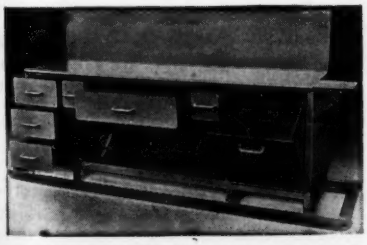
TYPE "A" WORK BENCHES



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These all-steel, all-welded benches provide a convenient place for all hand tools on the rig. They save drilling dollars by reducing loss and damage of tools and by saving time ordinarily spent in looking for misplaced tools.

Six big drawers and a rag bin provide storage space for all the tools on your rig. Drawers are weatherproof and mounted on rollers for easy operation.

Owen Work Benches are sold through all supply stores and distributed in California by Howard Supply Co. Order one for each rig you operate . . . **they're available for immediate delivery.**

OWEN TOOL COMPANY

ROUTE 9 BOX 800-B V-2-4241 HOUSTON TEXAS

Clain County, Oklahoma, and just southeast of the Wood Oil Co. 1 Brackeen, in SE NE NW 14-5n-2w, producing from the Hunton. The new venture is the 1 Marshall, in NW SE SE 14-5n-2w.

Ralph Perry will drill on contract the Wilma Lyons 1 Edith Beilstein, in C N½ NW NE 22-3n-16w, Allegan County, Michigan.

Olsen-Blount Drilling Co. and Roger Harris have staked location for a test between the Olympic and Butner pools on the Seminole-Hughes County line in Oklahoma, and will take the 1 Belford, in SE NW SE 10-9n-8e, to the Wilcox sand.

Shaw Petroleums, Lloydminster, Sask., has finished drilling Dalo 1, NE LSD 1, 35-49-1w4 in the Lloydminster field, with total depth 2,004 ft. and oil sand at 1,994 ft. The same firm is rigging West End 1, LSD 15, 11-50-2w5 in the northwest extension of the field.

Meredith, Clegg, & Hunt, Houston, having completed Paso Ancho 64 as a producer for Humble Oil & Refining Co. in the south end of the Stratton field, Kleberg County, Texas, have moved and are now drilling Paso Ancho 88 in the same field. Contract depth is 7,200 ft.

Harry Stroud has been awarded drilling contract on the Leonard C. Sleep 3 Milton Ellinger, in NW NE NW 22-3n-13w, Allegan County, Michigan.

Dave Duncan, Big Spring, Tex., has drilling contract on the Ray A. Albaugh 1 Graves, southeast Dawson County, Texas, wildcat. Location is in the southeast corner of Section 48, Block 34, TP Survey T-4-N. Test has spudded in and was drilling ahead with rotary.

Parker Drilling Co., Tulsa, has purchased a new heavy-duty diesel-powered rotary rig from Shell Oil Co. of Canada, for use at its first Canadian contract, Gulf Research & Development Co. 1 Pincher Creek, which has been located in LSD 15, 24-3-29w4, in the eastern portion of the southern Alberta foothills not far north of the Montana boundary. The test will be drilled to 13,000 ft. if necessary. It is rumored that the contractor paid $150,000 for the rig, which is capable of 12,500-14,000-ft. drilling with 4½-in. pipe and up to 16,000 ft. with 3½-in. pipe. It was used by Shell for deep drilling at Shell-Norman 1 (Jumping Pound) and the Home-Brazeau Syndicate test. The rig is now at Calgary, but it is expected that it will be shifted to the Gulf drill site as soon as moving conditions permit. It is reported that Parker will use a largely Canadian crew.

Give tomorrow's work-over crew a break

. . . Leave the inside of the casing "clean as a hound's tooth" by running a BAKER CASING SCRAPER just above the bit when you drill out cement, or clean out after a perforating job. No tricks, no trouble.

BAKER *Rotary* **CASING SCRAPER**

ASK THE *BAKER* MAN

WEB WILSON *Tong Dies*

"IT'S A WILSON"

The ORIGINAL vertical tooth tong die. It penetrates hard tool joints, wears longer, is reversible and can't be put in backwards. Extra sharp teeth assure long life and avoid slipping on hard joints.

SEE COMPOSITE CATALOG FOR COMPLETE DETAILS

WEB WILSON *Oil Tools*

W. W. WILSON BUILDING
HUNTINGTON PARK, CALIF.

PERSONALS

McLaughlin Named Head of Texas Pipe Line Co.

R. B. McLAUGHLIN becomes president of Texas Pipe Line Co. after 40 years service with pipe-line activities of The Texas Co. interests. Since 1943 he has been vice president and manager of Texas Pipe Line Co. and Texas-New Mexico Pipe Line Co., also vice president of Texas Empire Pipe Line Co. and Kaw Pipe Line Co.

From his native town of Fredonia, Pa., he went to the Gulf Coast in 1906 at the age of 16 where he took a job in the Sour Lake, Tex., warehouse of the pipe-line department of The Texas Co. From laborer he became junior clerk and later paymaster. During the building of the company's Oklahoma-Gulf Coast line he was located in the Dallas construction office. Later he was in the general office at Houston.

When The Texas Pipe Line Co. was organized in July 1917, McLaughlin was elected assistant secretary and later served as secretary and treasurer. In June 1939, he became vice president and assistant manager of Texas Pipe Line Co. and Texas-New Mexico Pipe Line Co. In 1940 he was appointed a member of the American Petroleum Institute pipe-line valuation committee.

In March 1942 he was appointed associate director of transportation of the Office of Petroleum Coordinator for War, later known as Petroleum Administration for War. He returned from these duties to resume his responsibilities with Texas Pipe Line Co. and affiliated companies.

A. W. Cullen, geologist with Continental Oil Co., has joined Lion Oil Co. as division geologist in Denver.

James Healy, who was graduated early this year from the University of Michigan as a geologist, has joined Michigan Consolidated Gas Co., and has been assigned to its production and pipe-line division.

O. S. Hervey has resigned as geologist with Sun Oil Co. to become a senior geologist with Union Oil Co. of California. He will be stationed in Houston.

O. H. Eichelberger, former division superintendent of Pan American Gas Co., has been appointed district superintendent in charge of the newly formed South Central Texas district, which covers 14 counties generally surrounding Houston. **O. W. Fowler,** former district production foreman, has been named division superintendent.

Dr. John H. Maxson, former assistant professor of geology in California Institute of Technology, has joined Bay Petroleum Corp. as division geologist in the Rocky Mountain area. **Harry B. Allen,** with Bankline Oil Co. in California prior to the war, has joined Bay as a geologist in the Rocky Mountain division.

H. V. Atwell, supervisor of the fuels-research department of the Beacon, N. Y., laboratories of The Texas Co., has arrived in Germany where he will spend 3 months assisting in the interrogation of German scientists on petroleum developments. The work is a continuation of the 1945 Technical Oil Mission of which Atwell was a member.

Earl Westmoreland, district geologist, and **Lewis E. Sandy,** landman, are being transferred to Ardmore, Okla., by Seaboard Oil Co. of Delaware, effective with the closing of the company's offices in Jackson, Miss., March 1. **J. W. Rawley,** landman, is being transferred to Dallas, and **A. G. McCarver,** geologist, will remain in Jackson as a consultant.

F. B. Bimel, who retired as chairman of the board of International Petroleum Co., Ltd., Toronto, is now living at 573 Unadilla Avenue, Shreveport, La. He expects to make his permanent home in Shreveport where he lived for several years when he was connected with the Standard Oil Co. of Louisiana. He was active in the oil business for more than 40 years.

John B. Duckworth, assistant director of research of Standard Oil Co. (Ind.), has been awarded the Legion of Merit by the Army Air Forces for "exceptionally outstanding service in the development of engine fuels and lubricants for military aircraft." The medal was to be presented this week in a ceremony at the Army air base at Park Ridge, Ill. Duckworth, a former Army major, was cited for his work while test engineer, chief of the fuel unit, and assistant chief, fuel and oil branch, power-plant laboratory, headquarters, Air Material Command, from August 1942 to January 1946.

Don W. Jopling, president of Exploration Surveys, Inc., has resumed his duties as active head of the company following service in Alaska as consultant to Arctic Contractors, Inc., in charge of the geologic program in Petroleum Reserve No. 4.

Frederick P. Glazier has joined the Beacon, N. Y., laboratories of The Texas Co., as a mechanical engineer in the products - application department.

Richard McAlpine has been promoted from office assistant to production foreman at Odessa, Tex., by Atlantic Refining Co. Other Atlantic changes include: **John A. Myers,** from junior engineer to reservoir engineer at Dallas; **Elmer Murray,** from shift tester to water chemist, Point Breeze refinery; **Thomas J. Jeffrey,** junior engineer to production engineer, Magnolia, Ark.; **William O. Ramsey,** junior engineer to production engineer, DeRidder, La.; **Richard W. Coburn,** junior engineer to production engineer, Franklin, La., and **Thomas Jacks,** field engineer to junior engineer, Franklin, La. **Samuel B. Parks,** district foreman at Franklin, has been transferred to Venezuela as district superintendent, and **Gene E. Roark,** production engineer, has been sent to Dallas as junior petroleum engineer.

M. T. Smith, Shell Oil Co., Inc., has been appointed crude-oil representative for the company in the Midland, Tex., area, including New Mexico and West Texas.

Kingsley V. Schroeder, Sun Oil Co., has been promoted to chief geologist of the Beaumont division, at Beaumont, Tex.

T. E. Swigart, president of Shell Pipe Line Corp., has been reelected president of the Community Chest and Council of Houston and Harris County.

Cecil Ward, Bureau of Mines, has been named chairman of the Oklahoma Section of the American Chemical Society, succeeding **Grant C. Bailey,** Phillips Petroleum Co. Other new officers are **Howard L. Malakoff,** Cities Service Oil Co., vice chairman; **James E. Webster,** Oklahoma Agricultural and Mechanical College, reelected secretary; and **J. Donald Gibson,** Phillips Petroleum Co., treasurer.

R. R. Robison, former division drilling foreman in the Rocky Mountain area for Shell Oil Co., Inc., has been named superintendent in charge of the San Joaquin division.

Eugene Holman, president of Standard Oil Co. (N.J.), and **Joseph E. Pogue,** vice president of Chase National Bank, were among the industrialists and bankers who were lampooned early this month in New York at the "Financial Follies of 1947," an annual banquet given by the city's financial writers.

G. Allan Reid has been elected a vice president and director of South Penn Oil Co. to succeed **John L. Hays,** who recently resigned. For the past 20 years, Reid has been in charge of the New York office of Tide Water Associated Oil Co. He is a director of the Bradford District Pennsylvania Oil Producers Association.

Rae Preece has been appointed field manager, drilling and production department, Hancock Oil Co. of California, Long Beach. He also retains the position of chief geologist which he has held the past several years.

Fred H. Billups, former manager of domestic costs and operations for Standard Oil Co. of New Jersey, has been appointed marketing coordinator of northern and southwestern Europe for the parent company, Standard Oil Co. (N. J.)

R. S. Christie, Amerada Petroleum Corp., Fort Worth, has been named vice chairman of the North Texas Section, American Institute of Mining and Metallurgical Engineers, replacing **L. F. Peterson,** Stanolind Oil & Gas Co., who was recently transferred to Tulsa.

B. H. Robinson, assistant manager of production for General Petroleum Corp., has been appointed manager

B. H. ROBINSON

R. O. SWAYZE

of joint-interest operations, a newly created position. **R. O. Swayze,** assistant manager of the Rocky Mountain district, in another General Petroleum change, was made manager of the company's California drilling and production operations. Robinson joined the campany in 1925 as a timekeeper; Swayze first was employed as a clerk in 1921, later entering the geological department.

Glenn D. Bradford has joined Sinclair Refining Co. in Oklahoma City as a lubrication engineer.

C. B. Claypool, for the past 11 years division geologist in the Beaumont division of Sun Oil Co., has resigned to enter private practice in consulting geology and geophysics, with offices in Houston. He will be associated with **Gordon I. Atwater,** consulting geologist of New Orleans.

A. C. Long, formerly assistant to the vice president in charge of foreign operations for The Texas Co., has been elected a vice president of California Texas Oil Co., Ltd., a subsidiary of Texaco and Standard Oil Co. of California. Long will be in charge of Caltex marketing operations west of Suez, particularly in the United Kingdom, Eire, continental Europe, and North Africa.

Charles B. Gannaway, Jr., plant manager of Tulsa Boiler & Machinery Co., has been elected president of the Engineers Club of Tulsa. Other new officers are: executive vice president, **Ernest M. Newland,** Oklahoma Steel Castings Co.; secretary, **Dean E. Foster,** Bethlehem Supply Co.; treasurer, **J. Murray Walker,** Lane-Wells Co.; vice presidents, **Robert G. Smith,** General Electric Co., **Lloyd E. Elkins,** Stanolind Oil & Gas Co., **Raymond M. Carr,** Sinclair Prairie Oil Co., and **W. J. Myers, Jr.,** Public Service Co. of Oklahoma, and directors, **F. W. Robson,** The Happy Co., **T. D. Williamson, Jr.,** T. D. Williamson, Inc., and **H. M. Cooley,** Bethlehem Steel Co.

Shifts

John C. Lynch, engineer, Richfield Oil Corp., Bakersfield, Calif., to Long Beach; **Robert W. Blake, Jr.,** engineer, Union Oil Co. of California, Wilmington, Calif., to Compton, Calif.; **H. B. Henry,** foreman, Richfield Oil Corp., Wilmington, Calif., to Long Beach; **Arnold S. Bunte,** engineer, Vickers Petroleum Co., Roswell, N. M., to Oklahoma City; **Winford A. Neill,** engineer, Sun Oil Co., Delmita, Tex., to Kilgore, Tex.; **J. N. Conley,** geologist, Seaboard Oil Co. of Delaware, Marlin, Tex., to Roswell, N. M.

E. L. Wells, foreman, Continental Oil Co., Mineola, Tex., to Grenada, Miss.; **A. W. Black,** foreman, Continental Oil Co., Cheyenne Wells, Colo., to Davis, Okla.; **Austen M. Shook,** engineer, The Texas Co., Premont, Tex., to Freer, Tex.; **R. W. Erwin,** engineer, Salt Water Control, Inc., El Campo, Tex., to Dallas; **R. E. Wright,** engineer, The Texas Co., El Campo, Tex., to West Columbia, Tex.; **J. F. Scott,** engineer, Pan American Transport Co., Galveston, Tex., to New York City.

J. M. Meyers, foreman, Helmerich & Payne, Inc., Crane, Tex., to Andrews, Tex.; **L. F. Peterson,** engineer, Stanolind Oil & Gas Co., Fort Worth, Tex., to Tulsa; **Carl Cooper,** superintendent, Wampler Brothers Drilling Co., Gladewater, Tex., to Oklahoma City; **Richard A. Pohly,** geologist, Global Exploration Co., Houston, Tex., to Denton, Tex.; **E. M. Sullivan,** superintendent, Pure Oil Co., Houston, to Natchez, Miss.; **D. C. Phinney,** engineer, Celanese Corp. of America, Kingsville, Tex., to New York City.

D. H. Cardwell, geologist, Sun Oil Co., Midland, Tex., to San Antonio, Tex.; **O. K. Austin,** engineer, Phillips Petroleum Co., Phillips, Tex., to Bartlesville, Okla.; **Dwayne W. Cunningham,** engineer, The Texas Co., Port Arthur, Tex., to Casper, Wyo.

C. C. Alexander, engineer, The Texas Co., Loeville, La., to Golden Meadow, La.; **Robert M. Caywood,** engineer, Stanolind Oil & Gas Co., Vivian, La., to Davis, Okla.; **K. A. Simmons,** geologist, Centralia, Ill., to Oklahoma City; **Roscoe C. Clark, Jr.,** engineer, Dowell, Incorporated, Flora, Ill., to Mt. Pleasant, Mich.; **J. H. Jackson,** superintendent, Sun Oil Co., Laurel, Miss., to Brookhaven, Miss.; **Thomas V. Sheehan,** engineer, Standard Oil Co. (Ind.), Laurelton, L. I., N. Y., to Brooklyn.

Thomas H. Cole, engineer, Inland Drilling Co., New York City to Midland, Tex.; **T. L. Kunkel,** foreman, The Texas Co., Liberal, Kans., to Perryton, Tex.; **E. L. Smart,** superintendent, Stanolind Oil & Gas Co., Pratt, Kans., to Altus, Okla.; **Paul Weirich,** foreman, Phillips Petroleum Co., Rock Springs, Wyo., to Glenrock, Wyo.; **E. F. Bourne,** foreman, Pure Oil Co., Madill, Okla., to Nowata, Okla.

Play to "break par" *on any hole!*

The player who "breaks par" on a golf course, with the allotted number of strokes a hole, is at the top of his form... He must have skill, good judgment, practice, coordination, to put up that kind of a showing ... In deep well oil pumping, users of *Axelson Sucker Rods* find that they make a high score, in this operation, and jot it down in the profit and loss account... *Axelson Sucker Rods* are *right* in materials, heat treating, uniformity and pin-end design and workmanship ... Axelson engineered holes produce on recommendations that reduce the risk of down-time, through rod failure, to a minimum... Plan to "break par" on your oilfield course, with Axelson rods.

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AXELSON

DEEP WELL PLUNGER PUMPS AND SUCKER RODS

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

Equipment Men in the News

Jones Succeeds Schweinhard

George W. Schweinhard, vice president and general manager of Bethlehem Supply Co. of California, retired February 28 after

SCHWEINHARD

W. M. JONES

25 years as active head of the company he founded. He is succeeded by Wendell M. Jones, who has been with the company since 1926. Announcement of the retirement of Schweinhard and the appointment of Jones is made by H. H. Fuller, president of the company.

National Tube Makes Sales Changes

Effective March 1, F. A. Marsh, formerly manager of sales of the Houston sales office of National Tube Co., has been appointed assistant to vice president in charge of sales, succeeding J. B. Graham who retired February 28, it is announced by W. F. McConnor, vice president in charge of sales. At the same time, Henry J. Wallace, general manager of sales, announced that G. F. Coons, formerly manager of sales of the New Orleans sales office, has been appointed manager of sales of the Tulsa office, succeeding E. E. Smith, who has been transferred to the Houston sales office as manager of sales.

Parsons Organizes Firefighting Company

Claude P. Parsons has arranged with the Hughes Tool Co. for his release so that he can devote more time to helping the industry organize an oil well blowout and firefighting company to handle wild wells on a more organized and scientific basis than in the past.

Several months ago a group of operators and drilling contractors asked Parsons to be chairman of a committee to explore the various aspects of the unusual type of organization required for this highly specialized purpose. A charter has been applied for, naming Parsons as president, Myron Kinley as vice president, and W. W. Flenniken as secretary-treasurer.

Vapor Recovery Closes Tulsa Office

John L. Shaunty, Mid-Continent manager of Texas Vapor Recovery Systems Co., is now in charge of all business in the Tulsa area since the closing of the Tulsa office. He maintains his office in the M. & M. Building, Houston.

Pryor Elected President

J. F. Pryor, Houston, has been elected president of Magnolia Airco Gas Products Co. W. A. Sherman and R. F. Crow, former president and executive vice president, who have been closely associated with the company for many years, will continue their association as directors. Also appointed vice presidents were R. A. Merritt, former general manager of sales at Houston; and J. D. Schwartz, former branch manager at El Paso.

Marks and Davidson District Managers

Republic Flow Meters Co., Chicago, announces appointment of Christian W. Marks as manager of its Cleveland district which includes Northern and Eastern Ohio, Western New York, and Erie, Pa. The Cleveland office is located at 830 Vincent Avenue. Eugene N. Davidson is manager of its St. Louis district which includes eastern half of Missouri, southern half of Illinois, and western Kentucky. The St. Louis office is located in Room 480, Arcade Building.

American Manufacturing Presents History of Rope

"Forty Centuries of Service," an industrial and educational motion picture telling the story of rope, will be shown at exhibits, conventions, and at jobber and dealer meetings throughout the country by American Manufacturing Co., Brooklyn. The picture covers the historical background of rope and phases of its present-day manufacture.

Green Oil Field Products Manager

NORRIS GREEN

Announcement of appointment of Norris Green as acting field manager of Thermoid's Oil Field Products Division has been made at the company's Trenton headquarters by Jack Owen, vice president. Named to replace Paul Kelting, who died in December, Green will have headquarters at 1121 Rothwell Street, Houston. Prior to this appointment he had been district manager for Thermoid at Birmingham.

Connor Made St. Louis Manager of Superior Engine

J. D. Connor has been made district manager at St. Louis of the Superior Engine Division of The National Supply Co., according to an announcement by Robert M. Pearson, manager of sales of the division.

Klafstad Vice President of Crosby Steam Gage

W. P. Husband, Jr., president of Crosby Steam Gage & Valve Co., announces that Erling Klafstad, who has been connected with the company for 18 years as chief engineer, was elected a vice president of the company, in charge of operations and engineering, at a recent meeting of the board of directors.

Chain Belt Moves Houston Office

Chain Belt Co., Milwaukee, has announced the removal of the Houston sales office from 2015 Second National Bank Building to 2023 South Shepherd Drive. A. B. Calkins, sales representative, is in charge of the office.

Patton Parkersburg South American Engineer

W. R. PATTON

A. G. Evans-Lombe, vice president in charge of sales of The Parkersburg Rig & Reel Co., has announced appointment of W. R. Patton to serve as sales and service engineer in South America. Patton will sail from New York some time in March for Venezuela and will spend several months in the oil fields of Colombia and Venezuela, after which he will establish permanent headquarters in Caracas.

Independent Eastern Board Named

In addition to the election of officials of Independent Eastern Torpedo Co. described in the March 1 issue of The Oil and Gas Journal, the following were elected to the board of directors: C. M. Burlingame, C. M. Burlingame Co., Chicago; J. W. Irwin, general manager of Ohio Pipe & Supply Co., Cleveland; W. H. Brackney, Brackney & McClure Co., Toledo; F. M. Frapo, executive vice president, Indiana Wire & Steel Co., Muncie, Ind. The company has recently acquired the assets of New Mexico Glycerin Co., Artesia, N. M.

Cleveland Diesel Engine Appoints Hughes

George W. Codrington, general manager, Cleveland Diesel Engine Division, General Motors Corp., Cleveland, announces the appointment of T. E. Hughes as general sales manager and B. H. Gommel as commercial sales manager. Hughes was for many years manager of the Washington, D. C., office and Gommel was formerly service manager. Their headquarters will be at the division's plant in Cleveland. J. S. Melton has been transferred from the Cleveland office to Hughes' old post as manager of the Washington office.

Mendenhall to Head Torpedo Sales

Robert (Bobby) Mendenhall, for the last 3 years scout for the Gulf Oil Corp. in the West Central Texas zone, has resigned and will assume duties as head of the sales department for the Mendenhall Torpedo Co. of Wichita Falls. He is succeeded by Dean L. Wood, of Corsicana.

Westinghouse to Operate California Plant

Westinghouse Electric Corp. will take over operation of the Sunnyvale, Calif., plant of Joshua Hendy Iron Works under a lease arrangement. Westinghouse is entering into a 10-year lease with option to purchase the California plant, according to a joint announcement by John A. McCone, president of Joshua Hendy, and Harry F. Boe, vice president in charge of the Westinghouse Manufacturing and Repair Division. The 57-acre plant will be operated under the direction of Boe and will become the largest of 37 manufacturing and repair plants which Westinghouse operates in 25 states, in addition to its principal manufacturing divisions.

Foster Cathead Appoints Evans

Foster Cathead Co., Wichita Falls, has announced the appointment of Allen C. Evans as special factory representative stationed at Houston. Evans formerly worked for Wilson Supply Co.

Classified Advertising

The Market Place for the Oil Industry

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FOR CABLE TOOLS
see
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE: Holiday Detector. Used very little. Complete except spring electrode. Price reasonable. Box B-635, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: 1—16 Ft. National Band Wheel Power. 1—30 H. P. Bessemer Engine, Belt, Idler and Building Complete. George McGinley Supply Co., Bowling Green, Kentucky.

FOR SALE: Pumping Units. All types & sizes. New and used. Bridgeports, Jensens, Americans, Atlas, Ideco, with or without Power. Glenn Supply Co., 3600 Sand Springs Road. Phone 3-9607, Tulsa, Okla.

TWO MODEL RXIV 225 H.P. reconditioned gas-gasoline engines, complete with radiators and power takeoffs. One equipped with engine starter. Will sacrifice in order to make quick sale. Empire Oil Field Machinery Co., Box 4026, Odessa, Texas. Telephone 1480.

FOR SALE: Complete 5000′ drilling rig. Unit U-10. Draw works powered by two Caterpillar D 13,000 engines; Oilwell 14P pump; 94′ cantilever mast and substructure; 10 KW Diesel Light Plant; bunk house; tool house; 5,000 feet of 3½″ drill pipe. Rig now running at Pettus, Texas. Falco Oil Well Service, Box 1255, Alice, Texas.

JUMBO D Fort Worth Spudder in A-1 condition with 15-inch to 6-inch tools, motors, and light plant; built-in Shear pole. Now drilling in deep test and additional contracts available. Good price on contract. Poor health requires selling on term contract coming up. Box B-611, The Oil and Gas Journal, Tulsa, Oklahoma.

NEW BOLTED AND WELDED STEEL TANKS FOR SALE

10—10,000 bbl. bolted steel Tanks.
10—5,000 bbl. bolted steel Tanks.
50—500 bbl. bolted steel Tanks
25—1,000 bbl. bolted steel Tanks.
50—100 bbl. bolted steel Tanks.
Also Grain Tanks, Rental Tanks and Reset Tank Work.

INDEPENDENT TANK MFG. CO
Box 102, Seminole, Okla. Phone 977

EQUIPMENT FOR SALE

FOR SALE: Six New Kobe, 2½ inch tubing insert, pumps, one Triplex—Bargain for immediate sale. Ben Beckham, Jr., Box 134, Overton, Texas. Phone 3921.

LUMBER FOR SALE: 3x6 and wider 10 to 16 rough Oak $58.00 f.o.b. mill. E. J. Gaiennie, Lumber, Box 1074, Shreveport, Louisiana.

FOR SALE: Fort Worth "H" Spudder, steel pole with good cordage and drilling tools. Power No. 4600 Caterpillar Diesel engine. Frank F. Young, Chanute, Kansas.

FOR SALE: All kinds of atmospheric coolers, Tulsa, Coynoco and GR, all in first class condition. ENGLE PETROLEUM INCORPORATED, P. O. Box 72, Mt. Carmel, Illinois.

AVAILABLE WITHIN 30 Days: 80,000′ of 3½″, 4″ and 5″ O.D. Flues. Used in Gas System with as much as 300# pressure. Will be removed from ground in 40′ lengths. Suitable for welding. Box B-527, The Oil and Gas Journal, Tulsa, Oklahoma.

WELL DRILLING Machines, Spudders, Core drills, Standards. Complete stock cable tools. Used equipment reconditioned. Some Government surplus. Pressey & Son, Pueblo, Colorado.

2—OCS Pup Servicing Winches mounted on DS40 International Trucks complete with 2 & 2½ Rod & Tubing Tools as Illustrated in Fig. 410, page 3028 of 1947 Composite Catalog. C-A Well Service, Fairfield, Illinois

FOR SALE

4 Second Hand LeRoi "RXIV" 8-cylinder, 6¾″x7″ Standard Drilling Engines complete with LeRoi Gasoline Starting Engines, Twin Disc Heavy Duty Oil Field Clutch, Model X-7189, B-218-POO Standout 16-11/16″ Shaft 3-15/16″ Diameter x 10″ Long, 1″ x ½″ Keyway.

One pair of engines drilled approximately 8200 hours and the other pair 9000 hours.

THE NATIONAL SUPPLY CO.
Olney, Illinois

EQUIPMENT FOR SALE

FOR SALE OR RENT: 8,000′ 4½″ A.P.I. Full Hole Drill Pipe. Melton Well Service, Seminole, Oklahoma.

FOR SALE: Diesel Engine powered rotary drilling rig, suitable for 5,000′ drilling. Priced cheap for quick sale. Phone 306. Box 1360, Seminole, Oklahoma.

FOR SALE: One 7¼ x 10″ and one 7¼ x 14″ Gardner Denver pumps—overhauled—good condition. Also, one 82 CFT Gardner Denver Air Compressor. Drillers Machine Shop, Box 4532, Oklahoma City 9, Okla., Phone 6-3281.

FOR SALE: One Cardwell — Model R Spudder almost new, complete with tools, butane equipment and good lines. One 1945 model Autocar tandem with 11 x 24 rubber, almost new truck. One 2½ ton 6 x 6 complete with Tulsa winch & oil field bed, also new motor in truck. One T. D. 14 tractor complete with dozer & winch, this tractor in perfect condition. One low-boy trailer, good rubber. One float trailer, good rubber. One large short couple trailer for tandem truck, new rubber. One G.M.C. 1½ ton truck & trailer, 42 model, new rubber and in good condition. Telephone 237-J or Box 693. Grayville, Illinois.

FOR SALE

STEEL STORAGE TANKS

67—10,000 Gallon Capacity Tank Car Tanks

CLEANED PAINTED TESTED

Located in Oklahoma

IRON & STEEL PRODUCTS, INC.

42 years' experience
13412 S. Brainard Avenue
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"ANYTHING containing IRON or STEEL"

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TUBES and PIPE

all types and sizes

Write, wire or phone for quotations. Also motors, machinery and kindred items.

SONKEN-GALAMBA Corporation

Kansas City, 18, Kans.

OVER STOCK

PRICED TO SELL

1—IDECO model 5060-L525 Service Winch. NEARLY NEW Fawick Air Clutch. BUDA Gas-Gasoline 80 h.p. Motor.

1—CARDWELL model H. Single Drum Service Winch, with model 6 cyl., MZF WAUKESHA Gas-Gasoline Motor. FAIR CONDITION.

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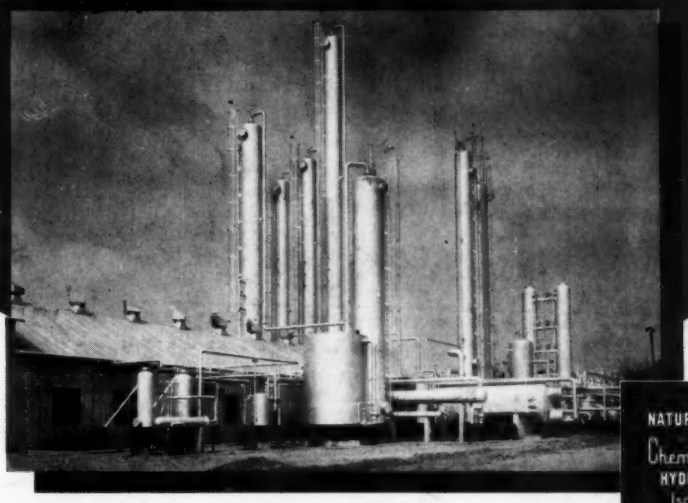

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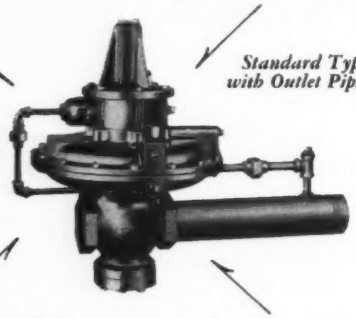

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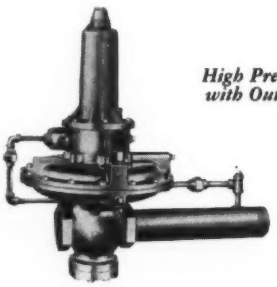

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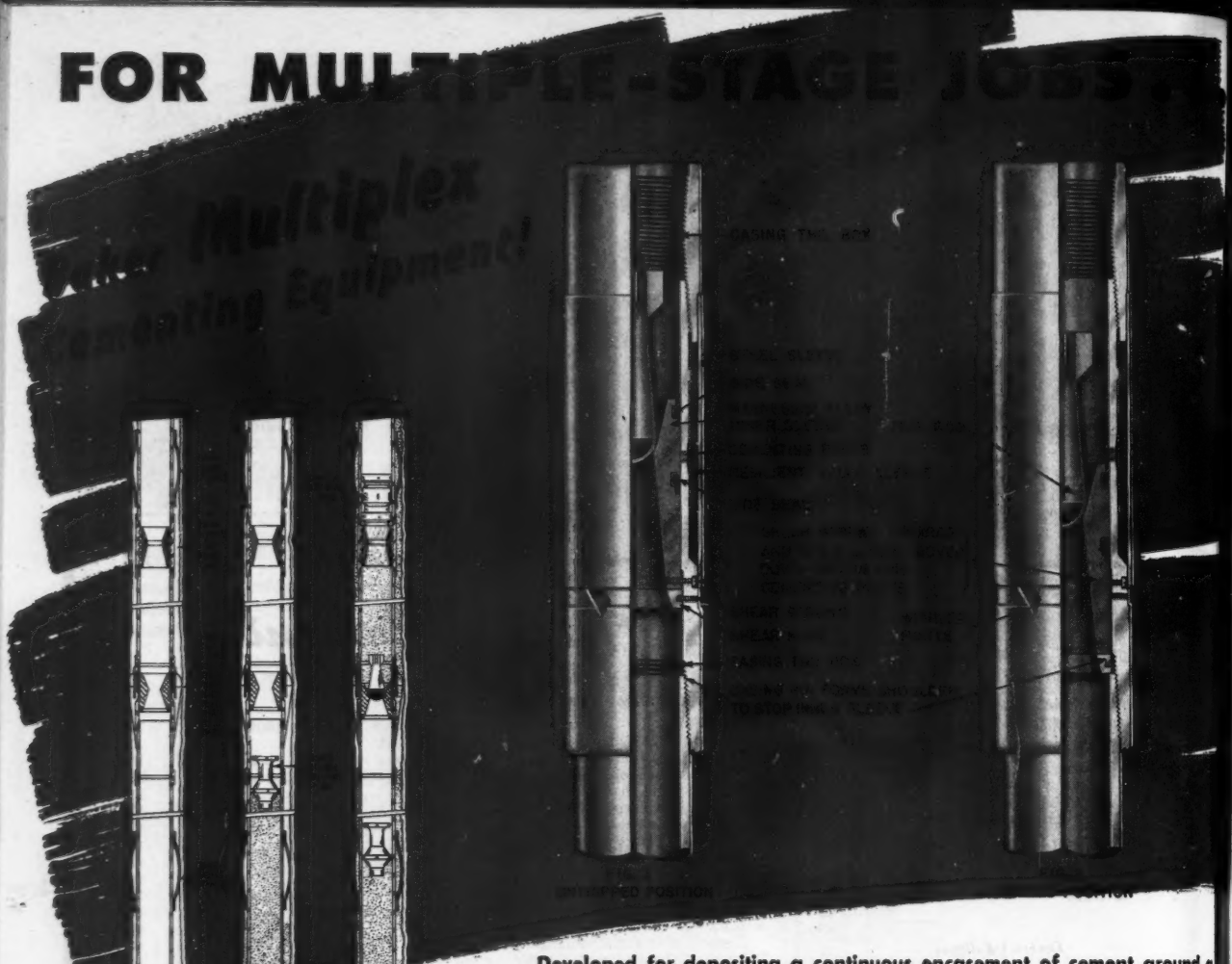

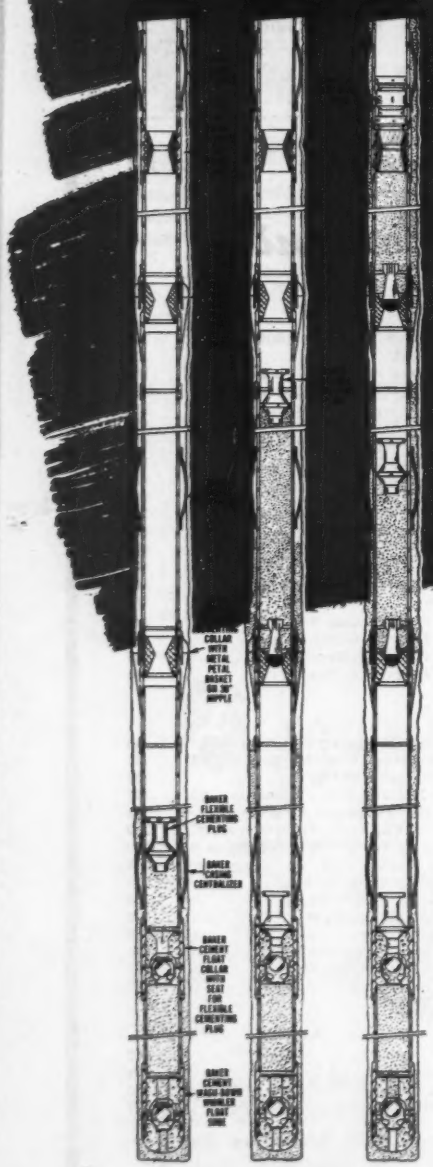

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Manufacturing Responsibility

THE owners of 365 active refineries in this country over the remainder of this year are faced with the greatest manufacturing responsibility in the history of the oil industry. As revealed in the statistical analyses of this Annual Refining Number, the demands to be supplied by domestic refineries will increase substantially over the record totals of last year.

Crude runs to stills must average about 4,900,000 bbl. daily for the year which means that starting soon the active plants must process in excess of 5 million barrels daily of domestic and imported crude oils.

The operating plants have a total capacity of slightly less than 5,400,000 bbl. daily. The small capacity represented by the inactive plants can be generally ignored in any projection of supplies this year. The history of shutdown refineries in this country is that their status rarely changes.

The problem confronting refiners is not lack of over-all capacity but rather that of not having adequate refining facilities at the right places. While the increases in demand since prewar days have been fairly uniform as to geographical distribution, there have been important changes in supply based on crude-oil production affecting refinery operations.

A case in point is the increased movement of West Texas and other Texas crude oil to Middle West refining centers. These shipments, which are to be further expanded with the completion of new pipe-line projects this year and in 1948, are necessary because prewar sources of supply for Middle West refiners—principally Oklahoma and Kansas—have not kept pace with postwar demands.

Aside from the large increase in the consumption of their products all refiners are confronted with the necessity of modernizing and rounding out their plant operations. War-product processing with its emphasis on quality of products and new methods has established new standards for peacetime operations.

Many refiners are in a position to add to the octane ratings of their motor fuels as conditions justify. Many others must have new processing units before they can meet the competition. Improvement in quality of industrial and motor lubricants and changes in processing methods have been outstanding, with demands this year to be nearly 20 per cent greater than in 1941. Gains in the consumption of the intermediate cuts—kerosene, furnace oil, tractor fuel, diesel oils, and related products—are partially accounted for by improvement in performance characteristics. A petrochemical division awaits additional plant construction with the manufacture of synthetic-rubber ingredients established as a major enterprise.

Petroleum refining can take care of all demands provided it has the freedom to utilize an inherent flexibility in processing arts and provided the equipment and materials are available for plant enlargement to keep pace with an expanding market.

Limitations on Grandfather Rights Defined in FPC Opinion

WASHINGTON.—Neither a "grandfather" certificate nor any other kind gives a natural-gas company unlimited and perpetual rights to supply a market area free from any competition, the Federal Power Commission declared in a supplemental opinion in the case of the Michigan-Wisconsin Pipe Line Co.

Last November 30, FPC, by a 3 to 2 vote, granted a certificate to Michigan-Wisconsin to build a new natural-gas line from Hugoton field to the Detroit area, subject to future determination of the rights of Panhandle Eastern Pipe Line Co. to serve Detroit under its so-called grandfather certificate. Panhandle was serving Detroit prior to the 1942 amendment of the Natural Gas Act which began the certificate system.

In the supplemental opinion, dated March 12 and with Commissioners Olds and Draper again dissenting, FPC determined that Panhandle can still have a good portion of the Detroit market if it cares to accept a new contract offered by Michigan Consolidated Gas Co., the local distributor, and in addition the growing demands for gas along its entire system should permit it to operate at capacity in spite of competition in Michigan from the new line.

In discussing the scope of a grandfather certificate a subject of interest to all gas pipe lines in operation prior to 1942, the majority said it could not agree that the issuance of a grandfather certificate grants any exclusive legal right to a given market, including a prior right to serve future requirements.

"The needed supplementation of gas supply in a general region or a particular area in the public interest is an ingredient of the public convenience and necessity which this commission is under obligation to consider in issuing certificates under Section 7 of the act. Moreover, Section 7(g) of the act applies whether a company operates pursuant to a grandfather or a nongrandfather certificate.

"It seems clear that any privileges conferred by a grandfather certificate issued under the Natural Gas Act should not, as a matter of law, be extended beyond 'substantial parity' with the operation, service, transportation, or sale actually performed on February 7, 1942. It follows that any additional operation, service, transportation, or sale of natural gas, subject to the jurisdiction of the commission, not clearly covered by an existing grandfather certificate must be approved by a nongrandfather certificate."

California Producers Ask Crude Advance

PRODUCERS and government officials in the areas affected by the recent crude price increase were jubilant this week over the boosting of revenues, but in California, where prices remained unchanged, criticism of crude buyers and general dissatisfaction was expressed.

In Texas, Gov. Beauford H. Jester hailed the price advance as an assurance of a $7,500,000 increase in state revenues and said in 2 years it would, at current production rates, add $12,993,440 to the general fund, in addition to increasing school funds.

B. A. Hardy, president of the Independent Petroleum Association, in Shreveport, La., predicted the price hike will increase the number of drilling operations and uncover new oil reserves. The increase, he said, finally brings the selling figure in line with costs of exploration, development, and production.

In California, however, members of the Oil Producers Agency of California declared crude prices in that state now are 35 cents a bbl. below Mid-Continent schedules and termed the prices "completely inadequate." Some independent producers were advocating shutting in the wells until the price is raised. California purchasing companies are reported to be studying an advance in their postings.

Texas Eastern Asks FPC Operating Permit

WASHINGTON. — Texas Eastern Transmission Co. has applied to the Federal Power Commission for a temporary certificate to operate the Big Inch pipe line to move natural gas to the Appalachian area on substantially the same basis as is now being done by Tennessee Gas & Transmission Co.

The company will take possession of the lines May 1 under a temporary lease from War Assets Administration pending final transfer of title. As authorized by this lease, the company is asking FPC for permission to install and operate three compressor stations prior to November 1, 1947, to increase capacity of the lines to approximately 250,000,000 cu. ft. per day.

Company Asks to Drop Gas Pipe-Line Project

WASHINGTON.—The Federal Power Commission early this week took under consideration a request of Mid-Continent Gas Transmission Co. for permission to withdraw its application to build a natural-gas pipe line from Liberal, Kans., to a point near St. Paul, Minn., via Kansas City.

The newly formed company, which has headquarters in St. Paul, had asked for authority to construct two 26-in. lines from Liberal to Kansas City and a single 26-in. line from Kansas City to St. Paul.

Strike Shuts Down Deer Park Refinery

Pickets of the International Oil Workers Union (C.I.O.) last week formed lines before the Shell Oil Co., Inc., refinery at Deer Park on the Houston ship channel following a stalemate in negotiations between company and union representatives over demands for a substantial wage increase and other questions.

Walkout of about 1,650 members of the union local idled approximately 2,500 employes of the refinery, which has a crude capacity of 74,000 bbl. daily and a cracking capacity of 54,000 bbl. daily.

In a company statement, P. E. Foster, refinery manager, and B. M. Downey, manager of the chemical plant, said the strike will have no effect on retail sales of the company, since reserves sufficient to meet demand for several weeks are on hand. The managers said the company had offered wage increases and other benefits amounting to approximately $900,000 annually to the C.I.O.-represented employes.

Skeleton crews remained on duty at the plant to protect company equipment. The walkout was the first strike in the nation to force the shutdown of a major oil-industry plant in current wage negotiations.

U. S. S. R. Shipment Blocked

WASHINGTON.—A State Department request to ship oil-refinery equipment valued at $25,000,000 to Russia has been turned down by a subcommittee of the appropriations committee of the House of Representatives, Chairman John Taber revealed last week.

A similar request was turned down by the Senate appropriations committee several weeks ago.

Threats to Competition Discussed By O'Mahoney in Illinois Talk

FOUR courses of action "necessary for the preservation of the competitive system in petroleum as in any other industry" were outlined by Sen. Joseph C. O'Mahoney, Wyoming, chairman of the former Senate petroleum-resources committee, in a speech March 13 at the annual meeting of the Illinois Oil and Gas Association in Mount Vernon.

"First," O'Mahoney said, "every company which operates abroad and thereby expects the support of the Government of the United States should be required under a foreign contracts act to disclose to the proper agency of Government the principal terms of the contracts which it makes, either with foreign governments or with foreign competitors.

"Second, inasmuch as the liberty of the individual is circumscribed by the fact that a large part of modern activity can be carried on only through organizations, there should be a national rule of responsibility for all economic organizations. Yet in neither of these cases should government be given discretionary power to direct or control economic activity. The purpose of such laws should be only to establish the legal climate in which voluntary cooperation to preserve opportunity for the largest possible number may be carried on.

"Third, we should have domestic tax reform so that small enterprise may not be strangled by the tax collector.

"Fourth, we should be willing to enact legislation that will prevent continued economic concentration so that the small enterprises will not be crushed by the superior resources of giant competitors which, because of their size, take on the aspects of monopoly."

More than 600 oil men from six states attended the annual meeting of the Illinois association. Climax of the 1-day meeting was the annual banquet which was addressed by O'Mahoney; Charles Rayner, petroleum adviser of the State Department, and Hiram Dow, chairman of the Interstate Oil Compact Commission.

Walter Duncan, Jr., Mount Vernon, one of the largest independent oil operators in Illinois, was chosen president of the association to succeed Will I. Lewis, also of Mount Vernon. Other officers elected were: First vice president, T. B. Steele, Robinson, Ill., general superintendent of Kewanee Oil & Gas Co.; second vice president, A. J. Rosenlieb, Marshall, Ill., division manager of Ohio Oil Co.; secretary, J. C. O. Clark, Olney, Ill., division manager of Pure Oil Co.; treasurer, Basil Moss, Mount Vernon, division land man for Magnolia Petroleum Co. Joe W. Meehan, Olney, served as program chairman for the meeting.

"Oil men universally profess their faith in competition and in free enterprise," O'Mahoney declared. "Yet no one can deny the battle for independence becomes more strenuous. Restraints are sometimes imposed by Government, sometimes by the forces of economic concentration. Together, they have hedged about the area in which new enterprise may establish itself and prosper.

"It is not without significance that a few companies operating in the Middle East today control far greater resource of crude petroleum than were controlled by the old Standard Oil Co. before its dissolution."

Rayner told the association that oil is "more than a commodity. . . . It is a vital force that has become interwoven throughout our national security and our economic and political welfare. We cannot ignore its importance in the world today, and the statesmanship with which we handle our realization of its importance will be the measure of our contribution to the promotion of world peace."

Treaty Objectives Outlined

Adoption of the Anglo-American treaty, Rayner said, will give official recognition to principles which have formed the basis of our foreign trade. These, he said, include, availability of oil on a competitive and nondiscriminatory basis, respect of concession rights, protection of interests of producing country, and insistence upon equal opportunity. The agreement also provides for industry-government collaboration, he continued, which should aid in resolving differences with foreign governments at their inception, thus preventing them from growing into "issues of major importance which may lead to drastic unilateral action."

Rayner emphasized the treaty is entirely voluntary with no executive authority. He described it as a preliminary step to the formulation of a multilateral agreement to which all producing and consuming countries would be invited to subscribe.

The State Department official reviewed United States production and export-import figures showing that exports in 1938 were in a 4-1 ratio to imports while in 1946 imports came close to equaling exports. He also pointed out that the United States is now producing up to maximum efficient rate.

"It is not my intention in stating these facts to enter into a discussion of the extent to which future discoveries of oil will satisfy increasing production demands or whether this country is going to become in the future a gradually increasing net importer of oil. . . . My whole purpose in calling these facts to your attention is to point out that they stress the increasing importance of foreign reserves to our national economy. It has been my personal opinion for some time, that largely due to war developments with their accompanying technological improvements, we have entered into a period in which the demand for oil will continue to be far more universal and on far greater scale than was ever contemplated in prewar years."

Seeligson Field Hit By Gas-Waste Order

AUSTIN.—In a move to halt gas waste, the Texas Railroad Commission early this week sharply curtailed production of oil and natural gas in Seeligson field.

Effective April 1, the commission ordered the flow of oil and gas halted until flare gas is used for light or fuel, for chemical manufacturing except that of carbon black, for repressuring, or for extraction of natural gasoline with the residue returned to the producing horizon.

Chairman Ernest O. Thompson said the move was the "first time in history of proration in Texas" that the commission had "ever had to resort to this means to stop gas waste," and added the commission is "going after every field where gas is being flared excessively."

U. S. Promises to Protect Present Offshore Operators

WASHINGTON. — If the Government wins its present suit against California for title to offshore oil lands it will not take immediate action to oust the present operators as trespassers, Atty. Gen. Tom C. Clark told the Supreme Court during argument of the case last week.

This is a reversal of the earlier position of the Department of Justice in bringing a test suit, later dropped, to dispossess one of the oil operators. The new attitude apparently is designed to soften California's argument that commercial chaos would result if title were determined to lie with the federal Government. Some of the justices asked what bearing this has on the legal issues and the attorney general stated that it had no bearing but simply shows that the administration will consider all the equities involved.

Humble Gas-Conservation Projects Involve $10,000,000 Expenditure

INDICATIVE of the petroleum industry's recognition of the need for greater utilization of natural gas, Humble Oil & Refining Co. is currently engaged in a program involving gas-conservation projects costing more than $10,000,000.

Most of the projects are on the Gulf Coast. In a review of the program, Humble pointed out that movement of the chemical industry to the Gulf Coast area and the opening of greater markets for dry gas by the construction of major interstate pipe lines into Texas has given impetus to the casing-head-conservation program.

Projects which have been built or are under construction by Humble and jointly by Humble and other operators include:

A 1,600-hp. compressor station was added in the North Crowley, Louisiana, field to make possible the delivery of 8,000,000 cu. ft. of dry gas daily from North Crowley oil field into transmission lines. This project was completed in April of 1946 at a cost of $390,000.

Compressors were added at the company's Lovell Lake plant to make possible the gathering and processing of an additional 4,500,000 cu. ft. of dry gas daily and to boost the pressure so that the gas can be delivered into a transmission line already connected to the field. This unit was finished in May 1946, at a cost of about $170,000.

In the Amelia field, Humble added a 600-hp. compressor station late in 1946 to put casing-head gas from oil wells back into the ground at 2,600 psi. Approximately 2,500,000 cu. ft. of gas, formerly flared, has been returned daily to the sand since December 1, 1946, to repressure the oil horizon. Cost of this project was $165,000.

Early this year there was completed at the Katy cycling plant a $500,000 low-pressure system which processes some 8,000,000 cu. ft. of casing-head gas from the North Katy field daily.

Construction was begun early in the year also on a casing-head plant at Anahuac to process between 35,000,000 and 40,000,000 cu. ft. of gas daily and recover 30,000 gal. of gasoline. This plant, scheduled for completion by midsummer, will cost about $2,500,000.

Construction was begun early in March, jointly by Humble and Quintana Gas Co., on a $3,000,000 natural-gasoline plant in Tom O'Connor oil field near Refugio. This plant is designed to recover 36,000 gal. of liquid fuel from the 35,000,000 cu. ft. of casing-head to be processed daily when it begins operating late this year.

The Clear Lake natural-gasoline plant was recently completed at a cost of $2,250,000. It will process 50,000,000 cu. ft. daily of gas and casing-head gas and will recover about 36,000 gal. of liquid fuel daily.

Other casing-head-gas conservation projects built by Humble in Texas and Louisiana since the war are: Hawkins (East Texas), $310,000; Red Fish Reef, $16,700; Chalkley (Louisiana), $160,000; Roanoke (Louisiana), $78,000; Heyser (Southwest Texas), $1,200,000; North Tepetate (Louisiana), $55,000; and Kelsey (Southwest Texas), $12,000.

Sinclair Line to Join Gulf, Atlantic, Great Lakes

PLANS for construction of more than 3,000 miles of petroleum-products pipe lines, designed to connect with existing lines to bring Atlantic Coast, Gulf Coast, and Great Lakes refineries into a coordinated transportation system, were announced last week by Harry F. Sinclair, president of Sinclair Oil Corp. and Sinclair Refining Co.

In an interview in Houston, Sinclair said much of the pipe necessary for the expansion program already has been obtained and most of the rights-of-way acquired.

The proposed projects include:

A 10-in. pipe line from the Houston refinery on the ship channel northward to Fort Worth, Tulsa, Coffeyville, Kans., and Kansas City.

An 8-in. line eastward from Kansas City to St. Louis, across Missouri, southern Illinois and Indiana, connecting at Columbus, Ohio, with the Ohio products pipe-line division.

An 8-in. line from the Corpus Christi refinery to Austin and San Antonio, skirting Victoria, Luling, and Gonzales.

Details of the huge construction program were being studied by Sinclair and top company officials at a series of conferences in Texas last week. Inspection tours were scheduled to various Sinclair production and refining installations.

This map shows the general route of pipe lines in the projected Sinclair products system

Construction recently was completed by Sinclair on products pipe lines from Toledo to Columbus, Ohio, and from Toledo to Detroit.

On his trip to Texas Sinclair was accompanied by Samuel L. Fuller, director of Sinclair Oil Corp.; Ernest L. Hughes, assistant to the president; J. E. Dyer, vice president and general sales manager; Byrnes MacDonald, executive assistant; H. L. Phillips, director and president of Sinclair Oil Co.; George H. Taber, Jr., vice president of Sinclair Refining Co.; and P. E. Frank, chief engineer.

this week

PIPE LINE— Harry F. Sinclair announces company plans for construction of more than 3,000 miles of products lines. . . . System includes 10-in. Houston-Kansas City line and 8-in. Kansas City-Columbus, Ohio, line and will tie together Sinclair's refineries in the Gulf, Great Lakes, and Atlantic Coast areas. . . . ¶Gulf prepares for looping 105 miles of its present Midland-Lufkin, Tex., crude line. . . . Most of loops to be 10-in. . . .

NATURAL GAS— FPC lays down limitations to rights of "grandfather" certificate in another 3-2 opinion in Michigan-Wisconsin case. . . . ¶Panhandle Eastern files application for third phase of expansion program. . . . Facilities requested to cost approximately $23,464,000 and to lift capacity of Panhandle system to 580,000,000 cu. ft. daily. . . . ¶FPC announces Mid-Continent Gas Transmission has asked to withdraw application to build gas pipe line to Kansas City and St. Paul. . . .

PRICES— California producers agency reports dissatisfaction of West Coast operators with failure of purchasing companies to follow lead of Mid-Continent buyers in advancing prices. . . . ¶Products prices reach levels approximately 1 cent above quotations prior to March 10 advance. . . . Market generally continues tight with crude still in demand. . . .

INTERNATIONAL— Jersey Standard, Socony-Vacuum delay closing deal to buy interest in Arabian American pending settlement of differences with Cie. Francaise des Petroles. . . . Two companies guarantee bank loan to Arabian American to allow pipe-line construction and production expansion to be commenced in meantime. . . . ¶Unofficial reports indicate indefinite delay in action by Iranian Parliament on Russian oil concession in northern Iran. . . . ¶Russian State Planning Commission says 1946 U.S.S.R. production totaled 166,827,000 bbl., 12 per cent above 1945. . . . ¶California Texas Oil, Ltd., acquires Texaco marketing outlets in 17 countries, giving company wide distribution throughout Eastern Hemisphere. . . .

REGULATION— Texas Railroad Commission orders sharp curtailment of production from Seeligson field in move to halt waste of gas. . . . Order effective April 1 requires utilization of flared gas. . . .

LABOR— C.I.O. Oil Workers Union calls strike at Shell's Houston refinery in breakdown of negotiations over wage increases and other issues. . . . Refinery officials say stocks sufficient to continue retail distribution for several weeks. . . .

EXPLORATION— North Sun field, Starr County, Texas, has new, deeper gas-condensate sand at 6,470-80 ft. . . . Coastal Refineries has new, deep-pay discovery in McAllen field, Hidalgo County. . . . New oil pay zone for West Pridham Lake field, Victoria County, flows 83 bbl. per day from 2,959-61 ft. . . . ¶New Garvin County, Oklahoma, discovery flows 50 to 100 bbl. per hour on drill-stem test and suggests Katie and Southwest Antioch pools may connect to make major field. . . .

Among the major projects included in Humble Oil & Refining Co.'s current $10,000,000 gas-utilization program is the Clear Lake natural-gasoline plant, shown here in aerial view with the employe-housing section in the foreground. This plant will process and recover gasoline from 19,000,000 cu. ft. of gas daily from gas wells in Dickinson and Halls Bayou fields, and from some 31,000,000 cu. ft. of casing-head gas from Dickinson, Gillock, East Clear Lake, and Friendswood oil fields. In the past, oil-well gas in the latter group of fields has been flared, while gas from the Dickinson and Halls Bayou fields had been produced directly into the Humble company's Tomball natural-gas-system lines. The housing section for employes adjoining the Clear Lake plant consists of 12 units. An office building also has been erected, and a recreation plant is to be added soon (see story, opposite page)

LIGHT HYDROCARBONS to Fore in New A.P.I. Method of Estimating Reserves

by Charles J. Deegan

This article analyzes the recent A.P.I.-A.G.A. joint report on crude-oil and light-hydrocarbon proven reserves and answers the questions about those reports that have been most frequently asked by oil men. The new report is the first of its kind and therefore it was inevitable that many unfamiliar items would puzzle a large number of operators.

SUFFICIENT time has now elapsed since the first release of the joint report of the reserves committees of the American Petroleum Institute and the American Gas Association to determine what particular things in the new report are confusing to the average oil man.

This article will analyze the reports in such a way as to answer the questions which have been most frequently put to The Oil and Gas Journal editors.

First, what is the objective of the new report? It is a recognition of the growing importance of natural gas and light liquid hydrocarbons. They have grown to such importance that it is essential to have the facts about their proven reserves. As in any major task, the first report, being new and unfamiliar to most people, seems complicated. Also necessarily in a first-time report, there are some figures for which no comparison with the previous years is available. The alternative is to wait another year before publishing any figures, and the committee wisely decided that knowledge of the existing facts was too important to withhold publication for a whole year, solely to give a basis of comparison for all figures.

Condensate

Second, why are crude and condensate given separately, when last year they were combined? Condensate is more nearly allied with the other liquid hydrocarbons recoverable from natural gas than it is with crude oil. Moreover, with the development of modern cycling plants, the output of plants combines what might be loosely labeled "natural condensate" with natural or old "casing head" gasoline and other liquid products, such as are commonly produced by so-called natural-gasoline plants. So, condensate is a kind of middle link between the output of natural-gasoline plants and crude oil.

Separating the condensate figures achieves three objectives. It lets crude oil stand completely separate; it recognizes the size and importance of condensate fields; and it supplies the separate data for a logical middle link between crude oil at one end and the light liquid products from natural gas at the other end. It is significant that the condensate reserves are now being estimated by the American Gas Association committee, rather than the American Petroleum Institute committee.

Discussion of Tables

The tables accompanying this article are in general slight rearrangements of those put out by the two committees, but all data are from their reports. The arrangements are those which seem to answer the most commonly asked questions.

Table 1 gives a quick over-all view of what the committees have reported, and shows that since there was no December 31, 1945, estimate of "Other Natural-Gas Liquids," there is no basis for comparison for certain items. Table 2 is simply a rearrangement of the Dry-Natural-Gas Reserves data to put it into a form made familiar by the many annual reports on crude reserves.

Table 3 is a rearrangement of the data given by the committee on total light liquid hydrocarbons for last year and this year. Some of these data are given by states and some are not. This table gives a comparison of all

TABLE 2—NATURAL-GAS PROVEN RESERVES
(Millions of cubic feet)

	Natural gas reserves 12-31-45	Discoveries extensions and revisions	Total	Less 1946 production	Nat. gas reserves 12-31-46
Alabama	23	75	98	1	97
Arkansas	869,686	54,171	923,857	52,195	871,662
California	10,855,707	803,056	11,658,763	532,462	11,126,301
Colorado	396,282	—70,905	325,377	9,614	315,763
Illinois	268,000	33,500	301,500	33,500	268,000
Indiana	17,000	3,200	20,200	3,200	17,000
Kansas	13,250,605	636,771	13,887,376	206,532	13,680,844
Kentucky	1,436,800	44,200	1,481,000	95,000	1,386,000
Louisiana	19,849,393	3,170,050	23,019,443	607,932	22,411,511
Michigan	8,931	148,069	157,000	26,000	131,000
Mississippi	2,007,859	383,842	2,391,701	21,188	2,370,513
Montana	1,202,521	—319,521	883,000	29,599	853,401
Nebraska	375	—374	1	0	1
New Mexico	5,190,309	899,737	6,090,046	185,260	5,904,786
New York	76,000	900	76,900	7,000	69,900
Ohio	626,800	46,200	673,000	59,000	614,000
Oklahoma	10,079,938	1,311,815	11,391,753	655,908	10,735,845
Pennsylvania	520,000	61,000	581,000	78,000	503,000
Texas	78,306,676	10,154,021	88,460,697	2,097,238	86,363,459
West Virginia	1,928,300	116,700	2,045,000	205,000	1,840,000
Wyoming	816,763	252,379	1,069,142	33,545	1,035,597
Miscellaneous	81,399	265	81,664	4,443	77,221
Total United States	147,789,367	17,729,151	165,518,618	4,942,617	160,575,901

TABLE 1—PROVEN RESERVES OF LIQUID HYDROCARBONS AND NATURAL GAS IN UNITED STATES
(Thousands of barrels)

	Dec. 31, 1945	Dec. 31, 1946	Change
Crude oil	19,941,846	20,873,560	+931,714
Condensate only	884,967	1,050,794	+165,827
Other natural gas liquids	(*)	2,270,233	(*)
Total liquid hydrocarbons	(*)	24,194,587	(*)
Natural gas, trillion cu. ft.	147.8	160.6	+12.8

*Not available.

TABLE 3—LIGHT LIQUID HYDROCARBON PROVEN RESERVES
(Thousands of barrels)

State—	Condensate only 12-31-45 (1)	Other nat. gas liquids 12-31-45 (2)	Total nat. gas liquids 12-31-45 (3)	Condensate only 12-31-46 (1-A)	Other nat. gas liquids 12-31-46 (2-A)	Total nat. gas liquids 12-31-46 (3-A)
Alabama	0	(*)	(*)	(*)	(*)	0
Arkansas	16,051	(*)	(*)	(*)	(*)	61,600
California	91,942	(*)	(*)	(*)	(*)	308,272
Colorado	0	(*)	(*)	(*)	(*)	2,377
Illinois	0	(*)	(*)	(*)	(*)	1,340
Indiana	0	(*)	(*)	(*)	(*)	85
Kansas	0	(*)	(*)	(*)	(*)	82,492
Kentucky	0	(*)	(*)	(*)	(*)	16,071
Louisiana	130,890	(*)	(*)	(*)	(*)	419,396
Michigan	0	(*)	(*)	(*)	(*)	655
Mississippi	9,797	(*)	(*)	(*)	(*)	243,901
Montana	0	(*)	(*)	(*)	(*)	8,534
New Mexico	0	(*)	(*)	(*)	(*)	73,609
Ohio	0	(*)	(*)	(*)	(*)	1,714
Oklahoma	1,000	(*)	(*)	(*)	(*)	68,317
Pennsylvania	0	(*)	(*)	(*)	(*)	2,309
Texas	635,037	(*)	(*)	(*)	(*)	1,985,606
West Virginia	0	(*)	(*)	(*)	(*)	19,285
Wyoming	250	(*)	(*)	(*)	(*)	25,458
Miscellaneous	0	(*)	(*)	(*)	(*)	6
Total U. S.	884,967	(*)	(*)	1,050,794	2,270,233	3,321,027

*Not available.

TABLE 4—RESERVES—CRUDE PLUS CONDENSATE
(Thousands of barrels)

State—	Crude oil only 12-31-45	Crude oil only 12-31-46	Condensate only 12-31-45	Condensate only 12-31-46	Total crude plus condensate 12-31-45	Total crude plus condensate 12-31-46
Alabama	785	512	0	(*)	785	(*)
Arkansas	287,623	267,058	16,051	(*)	303,674	(*)
California	3,318,006	3,293,491	91,942	(*)	3,409,948	(*)
Colorado	259,830	299,870	0	(*)	259,830	(*)
Illinois	349,620	351,264	0	(*)	349,620	(*)
Indiana	41,243	44,070	0	(*)	41,243	(*)
Kansas	541,846	545,316	0	(*)	541,846	(*)
Kentucky	56,721	59,188	0	(*)	56,721	(*)
New York	81,189	76,289	0	(*)	81,189	(*)
Louisiana	1,558,891	1,651,797	130,890	(*)	1,689,781	(*)
Michigan	64,186	69,177	0	(*)	64,186	(*)
Mississippi	257,363	270,221	9,797	(*)	267,160	(*)
Montana	108,474	104,246	0	(*)	108,474	(*)
Nebraska	500	875	0	(*)	500	(*)
New Mexico	512,373	543,453	0	(*)	512,373	(*)
Ohio	29,681	29,220	0	(*)	29,681	(*)
Oklahoma	888,839	898,186	1,000	(*)	889,839	(*)
Pennsylvania	110,601	97,501	0	(*)	110,601	(*)
Texas	10,835,257	11,646,360	635,037	(*)	11,470,294	(*)
West Virginia	38,630	35,655	0	(*)	38,630	(*)
Wyoming	599,881	589,358	250	(*)	600,131	(*)
Miscellaneous	307	453	0	(*)	307	(*)
Total U. S.	19,941,846	20,873,560	884,967	1,050,794	20,826,813	21,924,354

*Not available.

available data on condensate, other natural-gas liquids, and total natural-gas liquids.

Table 4 is a rearrangement to show how to compare last year's crude plus condensate reserve figures with this year's. The condensate figures included in last year's figures are given by the committee, so that they can be removed from last year's totals, permitting direct comparison of crude reserves for the two years.

Table 5 will be of most interest to most oil men. It highspots the areas where the bulk of the change in crude-oil reserves took place. It is obvious that on net balance, increases in Texas and Louisiana accounted for practically all of the increase in total proven reserves of crude oil. Table 6 shows what data are available on condensate-reserves high spots.

Table 7 is an analysis of how and where the bulk of the additions to crude-oil reserves took place. New discoveries, following the now familiar pattern of recent years, accounted for only about one-eleventh of the total new oil; extensions and revisions for the remainder. The committee report this year gives the breakdown on the total United States between new oil from extensions to old fields, and new oil from upward revisions of previous estimates.

Revisions

The fact that upward revisions are about five times as great as new discoveries is not surprising. It is simply the other side of the coin that shows new discoveries so low in recent years. It is a trend that has been noticeable since 1939, and as discussed under "Reserves" in the color section of The Oil and Gas Journal, January 26, 1946, probably reflects changes in the industry's methods of operation in recent years.

The bulk of these upward revisions had to be in Texas. While the committees do not publish breakdowns of any state, experienced oil men agree that the bulk of the Texas changes were probably in the Corpus Christi-San Antonio and West Texas districts. In both areas they probably reflect the opinion of the committee members that reserves that formerly might have been considered "potential" or "potentially proven" have now attained the status of "proven" without any qualifications. The Agua Dulce-La Gloria trend in the former and numerous pre-Permian developments in the latter area could well account for a substantial part of these changes.

TABLE 5
(Thousands of barrels)

State—	Proven reserves of crude oil only 12-31-45	Proven reserves of crude oil only 12-31-46	Net change
Texas	10,835,257	11,646,360	+811,103
Louisiana	1,558,891	1,651,797	+92,906
Oklahoma	888,839	898,186	+9,347
Kansas	541,846	545,316	+3,470
California	3,318,006	3,293,491	—24,515
All others	2,799,007	2,838,410	+39,403
Total United States	19,941,846	20,873,560	+931,714

TABLE 6
(Thousands of barrels)

State—	Proven reserves of condensate only 12-31-45	Proven reserves of condensate only 12-31-46	Net change
Texas	635,037	(*)	(*)
Louisiana	130,890	(*)	(*)
California	91,942	(*)	(*)
Arkansas	16,051	(*)	(*)
Mississippi	9,797	(*)	(*)
All others	1,250	(*)	(*)
Total United States	884,967	1,050,794	+165,827

*Unavailable.

TABLE 7
(Thousands of barrels)

State—	New crude found during 1946— By new discoveries	By extension and revision	Total
Texas	126,594	1,441,158	1,567,752
California	13,876	276,787	290,663
Louisiana	25,857	207,018	232,875
Oklahoma	47,731	98,423	146,154
Kansas	12,629	87,319	99,948
All others	17,747	302,923	320,670
Total United States	244,434	2,413,628	*2,658,062

*From extensions 1,158,923; from revised estimates 1,254,705.

International

WORLD-WIDE OIL DEVELOPMENTS

Arabian American Gets Bank Loan; Moore Named President

ALTHOUGH consummation of the proposed expansion of partners in Arabian American Oil Co. has been postponed pending the outcome of current discussions and legal action in London, Arabian American last week announced plans for a working agreement, the significance of which is a $227,000,000 bank loan.

This capital has been guaranteed largely by Standard Oil Co. (N.J.) and Socony-Vacuum Oil Co., Inc., the two companies whose negotiations for stock interest in Arabian American and Trans-Arabian Pipe Line Co. are being held up due to legal action taken by Cie. Francaise des Petroles in British courts.

Coincident with Arabian American's working-agreement announcement, Jersey Standard and Socony-Vacuum issued statements to the effect that differences of opinion over the legality of Iraq Petroleum Co., Ltd.'s Working-Group Agreement of 1928 (the so-called Red Line Agreement) have not yet been settled. Nevertheless, plans for expanded production in Saudi Arabia as well as construction of the trans-Arabian pipe line will now be possible with the additional funds.

Indicative of the projected production-development plan in Saudi Arabia is the fact that Arabian American's President F. A. Davies has stepped down to a vice presidency in order to concentrate his efforts on additional production to fill the trans-Arabian line and to take care of other markets now being rapidly developed. Davies was among the first of the engineers and geologists to enter Saudi Arabia and has developed the the company's development activities since the beginning. It is hoped to increase Saudi Arabia's daily potential production to somewhere between 500,000 to 600,000 bbl. by the end of 1949. Currently, output approximates 200,000 bbl. daily.

W. F. MOORE

Election of W. F. Moore, general manager of foreign operations of The Texas Co., as president of Arabian American Oil Co. was announced March 14 by H. D. Collier, chairman of the board of Arabian American. F. A. Davies, former Arabian American president, has been made vice president in charge of production and exploration, relieving him of administrative duties in connection with the office of president so that he can concentrate his efforts on the development of production. Moore entered the service of The Texas Co. in 1920 as an assistant power-plant operator in the Texaco refinery at Port Arthur. In 1929 he was named assistant to the manager and later assistant to the vice president of the refining department. After other assignments with the company, he became in 1938 assistant manager of Texaco's purchasing department and a year later manager of the department. In 1943 he was made assistant to the vice president, foreign-operations department, and in 1945, appointed foreign-operations general manager

William F. Moore, general manager of The Texas Co.'s foreign operations, has been elected president of Arabian American. As general manager of Texaco's foreign operations, Moore's duties consisted of producing, refining, and sales operations. Arabian American is now jointly owned by Texaco and Standard Oil Co. of California.

The $227,000,000 working fund was split into two loans, one for $102,000,000 and the other for $125,000,000. When the pending negotiations are consummated, Jersey Standard will acquire 30 per cent of Arabian American's stock and Socony-Vacuum 10 per cent. The $102,000,000 loan was "in order to make funds available pending acquisition by Jersey and Socony-Vacuum of this stock," Arabian American's formal statement explained. "Upon completion of the acquisition by Jersey and Socony-Vacuum of stock in Arabian American, the purchase payments will be used to retire the loan." The loan will be for a 10-year period and of the amount, $76,500,000 has been guaranteed by Jersey and $25,500,000 by Socony-Vacuum.

This money will be used to accelerate the development of Arabian American's producing facilities and to install additional refining equipment. Construction of a railroad (The Oil and Gas Journal, March 15, page 57) to serve its operations in the producing fields is also contemplated as well as a deep-water port at Dammam on the Persian Gulf.

A separate loan of $125,000,000 is being arranged in order to provide funds for construction of the trans-Arabian pipe line from the Persian Gulf to some yet undisclosed Mediterranean port. This 15-year loan will be guaranteed by California Standard, Texaco, Jersey Standard, and Socony-Vacuum. It is planned that at such time as the stock interest in Arabian American is taken by Jersey Standard and Socony-Vacuum, they will also acquire similar percentages of stock in Trans-Arabian Pipe Line Co., now jointly owned by Texaco and California Standard. The Chase National Bank headed a group of U. S. banks making the loans.

In providing the press with "A Background Memorandum on Com-

pany Policies and Actions"—copies of which were distributed simultaneously with the statements explaining the delay in negotiations—Jersey Standard published the historical background and current developments dealing with Iraq Petroleum Co., Ltd. Socony-Vacuum did not participate in this explanation, but the facts pertaining to the case are practically identical for both companies which have a combined 23.75 per cent in I.P.C. through the jointly owned Near East Development Corp.

In this pamphlet it is explained that during 1946 legal advice was sought in Great Britain for some means whereby Jersey Standard could participate with a company operating inside the "Red Line area" and not have to do so in partnership with I.P.C. In the course of this inquiry, British lawers informed Jersey Standard that because of the enemy-alien status of Cie. Francaise—also a 23.75 per cent partner in I.P.C.—the Group Agreement of 1928 was no longer in existence. Thus, it develops that the initiative to declare the Red Line Agreement as no longer operative did not come directly from Jersey Standard (or that matter Socony-Vacuum) but rather from British lawyers.

"When therefore, in the summer of 1946," Jersey Standard explains, "Jersey accepted the opinion of counsel that the Group Agreement of 1928 was dissolved, it decided to express its willingness to join in a new group agreement—one which would, however, eliminate the old restrictive features. Socony-Vacuum . . . had independently reached similar conclusions. Shortly thereafter these conclusions were formally transmitted to the other Iraq Petroleum Co. partners.

"Since that time, all members have joined in active attempts to work out some new business arrangement which, while eliminating the old restrictive features, would go further in meeting the commercial needs of all participants. Under discussion are plans to expand substantially the production of Iraq Petroleum Co. and make this production available to the partners in proportion to their specific needs."

However, opinions differ on the legality of Iraq Petroleum's Group Agreement (the Red Line) as Eugene Holman pointed out last week in a separate statement, "and the situation awaits clarification, either by legal action or by a new group agreement. Discussions in this connection are proceeding actively. We are hopeful that a new agreement can be reached which, while eliminating the old restrictive features, will go further in meeting the commercial needs of all participants," Holman said.

Meanwhile, it has been learned that if Cie. Francaise des Petroles insists on a full legal hearing, the British courts—I.P.C. being a British company—undoubtedly will be reminded of a wartime opinion handed down by the House of Lords, the British equivalent of the U. S. Supreme Court. This opinion concerned the legality of a Dutch company and whether the enemy-alien status of the Dutch invalidated a prewar contract.

Great Britain's House of Lords held that as distasteful and even repugnant as it was to be reminded that Britain's good friend, the Netherlands, had been invaded and that this had resulted in the regarding the Dutch as enemy aliens, that sentiment had nothing to do with the case in point, and that the contract, ipso facto, was invalid.

(Discussions of the Red Line Agreement were published in The Oil and Gas Journal December 21, 1946, page 42 and January 18, 1947, page 44).

Technical Talks Feature I.S.A.P. Program

THE first international general meeting of the South American Petroleum Congress will be held in Lima, Peru, May 12-17. Organization officials, striving to attract as members private corporations, technical organizations, and individual producers, have scheduled a strictly technical program, barring discussions and questions of a national or international political nature.

Speakers will include: Roberto L. Valverde, first vice president of the Peruvian chapter of I.S.A.P., on "The Petroleum Industry in Latin America;" Dr. R. P. Russell, president of Standard Oil Development Co., on "Scientific Research in the Petroleum Industry;" Dr. Eugene J. Houdry, president of Houdry Process Corp., on "Catalytic Cracking;" and Dr. Gustav Egloff, president of the American Institute of Chemical Engineers, on "New Uses of Petroleum Products."

Member chapters and their presidents are: Bolivia, Rene Ballivian Calderon; Brazil, Avelino Ignacio de Oliverra; Chile, Hector Marchant Blanlot; Ecuador, Enrique Coloma Silva; Peru, Luis F. Diaz; and Uruguay, Carlos R. Vega Garzon.

The organization was formed largely through the efforts of R. Vegh Garzon, who envisioned a South American Petroleum Institute. An organizational committee was appointed in 1941 at the convention of the International Society of South American Engineers, and the first chapter was organized in Uruguay in December 1941.

Among those attending the meeting, in addition to the speakers, will be Enrique Canepa and Mario L. Villa, Buenos Aires equipment importers and former members of the staff of Yacimientos Petroliferos Fiscales; Oswald Wenzel, head of the petroleum department of the Corporation for Production and Development of the Chilean Government; Dr. Luis Perez, former minister of public works, who will represent the Venezuelan Government; Siro Vazquez, chief petroleum engineer of Creole Petroleum Corp.; N. P. Isenberger, manager of South American operations for Phillips Petroleum Co.; Dr. Julio Enrique Tasio, minister of mines and petroleum for the Colombian Government; and an Argentine delegation composed of Emilio A. Koch, delegation president; Eduardo A. Pasquinelli, Osvaldo Bracaccini, and Dr. Dardo Benigno Zucherino, Francisco Pedro Cesar de Luca Muro.

Bahamas Aerial Survey To Start in April

SOME time in April, an 80,000-sq. mile aerial survey of the Bahamas will get under way. The magnetic profile maps of the surrounding ground beneath water will furnish information concerning the basic geological structure of the area.

This survey, to be under the direction of the Aero Service Corp., will be carried on by financing of the following companies: Anglo-Bahamian Petroleum Co., Ltd., a subsidiary of Anglo-Iranian Oil Co., Ltd.; Bahamas Oil Co., a subsidiary of Superior Oil Co.; Standard Oil Co. (Bahamas), Ltd., a subsidiary of Standard Oil Co. (N. J.); Shell Overseas Exploration Co., Ltd.; and Bahamas Exploration Co., Ltd., a subsidiary of Gulf Oil Corp.

By use of an extremely complex system of electronic - communication and recording devices, two planes, DC-3's, will be guided by surface stations, using shoran, on four boats. The boats will be moved between anchorage throughout the area. About 7 months will be necessary to complete the survey. Only one plane will be used at a time, the other being a standby so as not to lose time in case the other needs repairs. *(Shoran technique was described in an article in The Oil and Gas Journal, July 6, 1946, page 74.)*

The survey is expected to be made additionally difficult due to the period of intense sun spot activity which causes frequent magnetic storms. Operations must cease during such storms.

Overseas Navigation, Inc., will handle the boats and surface shoran, assisted by an electronic maintenance crew.

Production Outside U.S. Due to Reach 3,211,000 Bbl. in 1947

by Warren W. Burns

WITH large-scale exploratory and development programs already in progress in every country where there is oil or where the probability of finding oil is favorable, total foreign crude-oil production in 1947, excluding Russia, is expected to reach approximately 2,610,000 bbl. daily.

This compares with 2,345,000 bbl. daily in 1946, a figure based on the latest reliable estimates. Earlier this year it was forecast that 1946's foreign production, exclusive of Russia, would be 2,669,000 bbl., a figure which has since been adjusted downward. However, the latest estimate is still far in excess of the 1945 foreign production which was about 1,804,000 bbl. daily.

The Middle East remained the area where crude-oil production is followed most keenly, and indicative of the reason is the fact that huge production comes from relatively few wells. For instance, Sir William Fraser, chairman of Anglo-Iranian Oil Co., Ltd., who was recently in the United States, pointed out that "the operating advantage which the Middle East has over most other oilfield areas is compounded of high yield per well, large individual fields, and complete freedom for unit development."

Production in the Middle East last year was 604,500 bbl. daily, compared with approximately 538,800 bbl. in 1945. The most notable increase there during 1946 was in Saudi Arabia where figures show a daily average of 164,400 bbl. contrasted with 58,400 bbl. daily. However, in the closing months of last year, Saudi Arabia was producing around 200,000 bbl. daily and this year the output is expected to be increased by an additional 45,000 bbl. daily.

Iran continued to provide the lion's share of Middle East oil production in 1946 with 403,100 bbl. daily compared with 383,500 bbl. daily in 1945. Bahrein's production last year remained at about 21,000 bbl. daily, or the same as in 1945.

Production from Kuwait, which got under way in June, averaged 18,900 bbl. when figured on a yearly basis. Actual production late in the year was around 40,000 bbl. daily with a potential of 45,000 bbl. With plans only recently announced for the formation of Middle East Pipe Lines, Ltd., with the point of origin expected to be Kuwait, and a feeder line from Iran, Kuwait's crude-oil output undoubtedly will be stepped up appreciably within a few years. The proven reserves here have been reportedly underestimated at 9,000,000,000 bbl. Middle East Pipe Lines, Ltd., will be 50 per cent owned by Anglo-Iranian, 40 per cent by Standard Oil Co. (N. J.), and 10 per cent by Socony-Vacuum Oil Co., Inc. Completion of this 26-30-in. line is expected by early 1950, with an estimated capacity of from 250,000 to 300,000 bbl. daily.

Iraq's 1946 production remained about the same as 1945, due largely to lack of additional pipe-line facilities, a matter that is being remedied by construction of two additional 16-in. lines paralleling the present 12-in. lines to Tripoli and Haifa. Daily throughput is about 45,000 bbl. through each of the pipe line segments, with another 6,700 bbl. being consumed daily within Iraq, or a total of about 96,700 bbl. By 1950, Iraq's daily production is expected to be around 275,000 bbl. daily.

Iran's Haft Kel

The greatest oil field in the world, outside of East Texas, in terms of current daily production, is Iran's Haft Kel which is producing about 182,500 bbl. daily from 24 wells, in contrast with the East Texas daily production of approximately 344,600 bbl. from 24,000 wells. Eventually, Saudi Arabia's Abqaiq field may be an equally prolific producer.

The latest estimate of Venezuela's daily crude production in 1946 indicates that the output climbed to 1,064,900 bbl. compared with 885,921 bbl. daily in 1945. Over half of that country's output was produced by Creole Petroleum Corp. Early last February, Creole's daily production was approximately 605,000 bbl. daily.

In 1947, Venezuela is expected to supply the bulk of the petroleum imports for the United States, or approximately 235,000 bbl., in addition to estimated imports of 30,000 bbl. daily from Colombia and 5,000 bbl. daily from Mexico. Daily production in Colombia last year dropped to 60,600 bbl. daily, the decrease being due to strike troubles toward end of the year. Mexico's 135,000 bbl. daily average output last year may climb in 1947.

Exactly how the dredging of the Maracaibo Bar in Venezuela will affect the oil picture is not too evident, and it is not too sure, for that matter, that the bar will be dredged, though it is reported that the Maracaibo Bar Commission probably will recommend that the bar be dredged enough to permit the entrance of ocean-going tankers and that the Venezuelan Government will appropriate funds for this project. Some years ago, the oil companies concerned studied the matter and deemed it financially unadvisable.

The crude-oil production situation in the Netherlands East Indies remains unsettled due to the political unrest there. However, indications are that these matters may be settled shortly, but not without the possibility of the Indonesian Government insisting upon the renegotiation of oil concessions. Aside from British Borneo, where production in 1946 was estimated to have been 10,000 bbl. daily, N.E.I.'s output last year was 25,000 bbl. daily. Currently it is up to about 45,000 bbl.

Sumatra's two wartorn refineries, Bataafsche Petroleum Mij. (Royal Dutch-Shell interests) and Nederlandsche Koloniale Petroleum Mij. (Standard - Vacuum Oil Co. subsid-

ESTIMATED 1946 WORLD PRODUCTION

Country—	Thousands of bbl. daily
United States (actual production)	4,748,400
Canada	19,900
Mexico	135,000
Colombia	60,600
Trinidad	55,000
Venezuela	1,064,900
Argentina	56,900
Peru	34,100
Others	8,200
Total Western Hemisphere	6,183,000
Austria	11,900
Germany	12,500
Hungary	14,100
Romania	88,700
Other European	8,200
Total European (excluding Russia)	135,400
Egypt	25,100
Iraq	96,700
Iran	403,100
Bahrein	21,000
Saudi Arabia	164,400
Kuwait	18,900
Total Near East and Middle East	729,200
British Borneo	10,000
N. E. I.	25,000
Total Oceania	35,000
South and East Asia	13,900
Russia	450,000
Total Eastern Hemisphere	1,363,500
Total world	7,546,500
Total foreign (excluding Russia)	2,348,100

ESTIMATED 1947 WORLD PRODUCTION
(Excluding the United States)

Country—	Bbl. daily
Canada	31,000
Mexico	130,000
Cuba	1,000
Colombia	93,000
Trinidad	63,000
Venezuela	1,058,000
Argentina	60,000
Peru	37,000
Other Latin America, mainly Chile	13,000
Total Western Hemisphere, excluding United States	1,486,000
Austria	15,000
France	1,000
Germany, excluding Soviet Zone	12,000
Great Britain	2,000
Hungary	15,000
Romania	85,000
Other European, excluding Russia	10,000
Total Europe	140,000
Egypt	22,000
Iraq	96,000
Iran	400,000
Bahrein	21,000
Saudi Arabia	245,000
Kuwait	40,000
Total Near and Middle East	824,000
China	1,000
India-Burma	12,000
Japan	4,000
Total South and East Asia	17,000
N.E.I., Borneo, New Guinea	144,000
Total Eastern Hemisphere	1,125,000
Total foreign, excluding Russia	2,611,000
Russia	600,000
Total world (outside U.S.A.)	3,210,000

iary), probably will be on stream shortly. The Shell refinery reportedly is ready to handle about 20,000 bbl. daily and the N.K.P.M. refinery may be sufficiently rebuilt to handle a similar daily throughput.

Russia remained the usual enigma in 1946, though statistics which are believed to be reliable indicated a daily crude production of 450,000 bbl., with all indications pointing to a greater output in 1947.

Total world production last year was 7,543,600 bbl. daily compared with 7,186,600 bbl. daily in 1945.

One of the first official indications of Russia crude-oil production was given by a recent report of the Office of International Trade which quoted the Russian State Planning Commission as reporting that the U.S.S.R. produced 166,827,000 bbl. during 1946. The total was 12 per cent over 1945 production.

Royal Dutch Offices

Officials of Royal Dutch Petroleum Co. have corrected a report that the main offices of the company were situated in the Netherlands East Indies following the invasion of Holland by the Germans. (The Oil and Gas Journal, January 25, page 131). The offices, now reestablished in The Hague, were moved directly to Curacao in the Netherlands West Indies in May of 1940 and remained there unitl their recent return to their former location.

Nationalization of Swedish Imports And Oil Sales Recommended

BELIEVING that the concentration of the oil business in a single company, in which the Swedish Government would hold at least 51 per cent of the stock, would make it possible to purchase oil abroad at lower prices, a "Committee of Swedish Experts" has recommended nationalization of imports and sale of gasoline and other oils as of July 1, 1948.

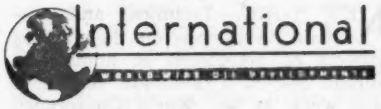
However, the petroleum refining industry, for the time being, is to remain in private hands, but the question of its nationalization under the oil-monopoly company should be considered later, according to the committee's report. Meanwhile, construction of a refinery at Kvarntrop, to run on imported crude oil, is to be studied. Kvarntrop is in the province of Narke where the government-owned shale-oil company is located.

If the fuel-oil business is nationalized, the report recommends that the monopoly should subsequently be extended to include lubricating oils. And according to the plan now offered, the distribution of gasoline and oils should be handled by the government monopoly, while retail sales would be in the hands of licensed retailers (private persons, companies, or organizations). It is further recommended that the question of obtaining a fleet of ocean-going tankers be considered. Currently, there are 39 tankers, with a dwt. of 343,906, under the Swedish flag.

Aside from the 51 per cent, or more, of the government-owned stock in the monopoly company, the remainder would be sold to private individuals, primarily the consumers, the report recommends. The company must not, it is emphasized, be utilized as an instrument of taxation.

Two of the five-member committee voted against a state monopoly, according to the report, but these two members reportedly agree with the majority that concentration of Sweden's oil business would result in savings. The minority members maintain that increased efficiency should be possible without nationalizing imports and sales.

The new Swedish oil-refining enterprises, and expansion plans of the Cooperative Union should ensure a competition sufficiently keen to serve as a safeguard against unreasonable prices, according to the two minority members. Furthermore, the minority members maintain that they count on a continuous supervision of measures apt to restrict free competition.



They also believe that a certain coordination of new constructions in the field of oil and gasoline distribution could be achieved through the city planning authorities.

Standard Oil Co. (N. J.), The Texas Co., Royal Dutch-Shell and Gulf Oil Corp. have Swedish affiliates engaged in petroleum marketing activities. Indemnifications to the oil companies for expropriated property, as well as to discharged employes, would be based upon the passage of a speial law, according to the experts' advice.

Indefinite Delay Seen In Soviet-Iranian Deal

While reports from the Moscow radio indicate that Russian scientists, wearing diving suits, are conducting exploratory work on the Caspian Sea bed, obviously anticipating formal approval by the Iranian Government of the projected Soviet oil concession in northern Iran, other reports are that this concession probably will not be ratified for at least 2 years.

When the Russians were conducting negotiations for this concession last year it was stated that approval was necessary by the Majlis (Iranian Parliament) by October 24, 1946. However, as the Majlis members had not been elected, Premier Ghavam stated that the discussion date would be extended until Majlis met, which may be within a few weeks.

However, with Russian troops finally out of northern Iran and with the abrupt change in United States foreign policy, one reliable source states that the question of approval probably will be delayed indefinitely. Russia negotiated for the concession contrary to an Allied agreement that such negotiations would not be conducted until all foreign troops were out of Iran.

Colon Development Output

Venezuelan crude-oil production of Colon Development Co., Ltd. (Shell) for the 4 weeks ending March 3 totaled 381,615 bbl., or approximately 13,628 bbl. daily. This compares with Colon's 4-week output, ending February 3, of 436,916 bbl., or approximately 14,563 bbl. daily.

World Oil to Grow in Importance, Fraser Tells A.I.M.E.

NEW YORK.—Technical and economic discussions on the various aspects of petroleum at home and abroad played a dominant role here this week at the World Conference on Mineral Resources, which was held in conjunction with the Seventy-Fifth Anniversary Celebration of the American Institute of Mining and Metallurgical Engineers.

Approximately 3,000 members and guests, with a representative from practically every country which has a vital stake in oil, attended. Prominent among foreign oil men was Sir William Fraser, chairman of Anglo-Iranian Oil Co., Ltd., who spoke on "International Aspects of the Petroleum Industry of the Future." From South America, Pedro Beltran, former Peruvian Ambassador to the United States, disoussed "Latin American Minerals in the Future World Economy."

Among the outstanding U. S. oil men who delivered addresses were Dr. Robert E. Wilson, chairman of Standard Oil Co. (Ind.), who spoke on "Petroleum and Natural Gas—Use and Possible Replacements," and A. J. McIntosh, economist for Socony-Vacuum Oil Co., Inc., whose address was on "Competitive Fuel Prices."

Representing the U. S. Government were Secretary of Interior Julius A. Krug who spoke on "Mineral Resources of the United States;" Assistant Secretary of State Spruille Braden, who delivered an address on "American Mining Enterprises in Foreign Countries;" and Assistant Secretary of State for Economic Affairs Willard Thorp, who spoke on "Tariffs, Cartels, and the Mineral Industry."

Abstracts of the various papers delivered at the technical sessions of the A.I.M.E. meeting commence on page 144.

Anglo-Iranian's Fraser explained that three continents, Europe, Africa, and Asia, are likely to remain the indigent oil clients of the remaining two continents, the Western Hemisphere and Asia, particularly the Middle East.

"Apart from what it has done to revolutionize all our ideas of mobility, the oil age has opened up possibilities of human betterment unattainable under any earlier system of power control; but there still remains a vast scope for betterment, particularly among those teeming millions in the Far East whose very lives are dependent on primitive methods of transport and agriculture."

Furthermore, the British oil official stated, "it is, as I have already said, the extreme disequilibrium in national resources which makes the international problem." He added: "It is this great task of making the oil resources of the world available insofar as possible to those who need them which, in the future even more than in the past, will in my view constitute both the duty and the opportunity of our great international industry."

. Paying particular attention to the Middle East, Fraser pointed out that the proved reserves at present are contained in 6 fields in Iran; 2 in Iraq; 1 in Kuwait; 3 in Arabia; 1 in Bahrein; and 1 in Qatar. Two of these fields, Masjíd-i-Sulaiman and Haft Kel, in Iran, have already produced about 100,000,000 tons (740,000,000 bbl.) each, and a third, Kirkuk, in Iraq, is approaching the 50,000,000 tons (370,000,000 bbl.) mark.

In terms of current rate of output, Fraser said, the Haft-Kel field has the distinction of being the world's largest producing field, with the exception of the great East Texas field. However, the East Texas production comes from about 24,000 wells, whereas Haft Kel is producing from 24 wells. Sixteen other wells in Haft Kel have been drilled for observation and control of gas oil and oil water reservoir levels. He continued:

Living Standards Improved

"From experience in Iran, which predates that of other oil enterprises in the Middle East, one can point with some pride to all that has been done to ease, and often to revolutionize, the general living conditions as they once existed in the operational zone. . . Far be it from me, however, to claim that this is particularly true to Iran. Rather, let me say, I think it represents—though not unfavorably so—a stage in the normal evolution of large-scale oil enterprise in territories which, apart from oil, are often singularly barren of natural or industrial resources."

Fraser's remarks about the success of large oil operations in foreign lands being largely dependent on the purely human side of the contact were echoed later by the Assistant Secretary of State Braden who said:

"It is pertinent to observe that the head representative in a foreign country of an American enterprise has tremendous responsibilities, perhaps in some ways greater than in an equivalent position at home. . . . He must be a man capable of dealing with cabinet ministers and if need be with the chief of state on an amicable basis and always with due deference for the sovereignty of the government."

Explaining that no nation can be economically independent of others, Braden said "to this end, there must be neither discriminatory and re-

SIR WILLIAM FRASER

A. J. McINTOSH

The outlook for the international oil industry was discussed by Sir William Fraser, chairman of Anglo-Iranian Oil Co., Ltd., at the World A.I.M.E. Mineral Resources Conference. Another speaker was A. J. McIntosh, economist for Socony-Vacuum Oil Co., Inc., who spoke on competitive fuel oil prices

strictive practices by the foreign country nor unfair exploitation by our enterprises" operating there.

Forecasting daily U. S. demand of 7,000,000 bbl. of crude oil or equivalent by 1970, Wilson said imports are bound to increase as the United States cannot continue producing 65 per cent of the world's oil from 30 to 35 per cent of the world's proved reserves. Exports are bound to decrease, he said, but "we must not allow imports to come in on a basis which will discourage the continued search for new reserves or the development of substitute fuels.

"We must have a strong vital industry, with the bulk of its reserves within our sphere of influence. This means first continuing to build up our reserves, making up any shortages by using those which American ingenuity has discovered elsewhere, and second, development of synthetic processes."

The cost of finding new reserves is about six times what it was a decade ago, he said. The annual use of gasoline per commercial vehicle probably will be 30 per cent higher by 1970. Diesel equipment will be used more widely, particularly on railroads and ships, he continued. Higher octane number will become increasingly difficult to supply, and when all gasoline must be upgraded, expensive processing will be needed to make high-octane components.

Socony-Vacuum's McIntosh expressed the belief that "the future holds great promise for an expanding market for petroleum fuels as against coal because everything seems to be moving to the advantage of oil." To substantiate this belief he said:

"When you consider that the anthracite-coal prices at retail have increased 43 per cent and that a comparable increase for No. 2 heating oil was only 20 per cent, it can immediately be seen that oil has gained a tremendous advantage over the last 6 years as compared to anthracite coal."

Oil Preferred Despite Price

Concerning bituminous coal, McIntosh said that "as a result of our calculations we found that in 14 selected cities covering the East and Midwest, the average price of bituminous coal to industrial users in 1946 was $5.48 per ton and that in the same cities the price of No. 6 fuel oil was $2.07. Conversion of the coal prices indicate that on an average the user of bituminous coal in industrial plants has a price advantage over oil. In looking over the situation, however, we find that advantage is confined to cities in the interior, whereas in coastal areas or along the seaboard, the oil user had the advantage."

From this, McIntosh observed that "this is an interesting point because in spite of these cash disadvantages that industrial users are faced with in this interior area, they are still clamoring for residual fuel oil which must indicate that the noncash items, or those that we call noncash, are of such magnitude as to make it still highly desirable to burn heavy fuel oil as against bituminous coal."

Stating that neither the United States nor any other nation which is or hopes to be industrialized can long remain isolationist, either economically or politically, Secretary Krug said "We have all become citizens of the world and we must think and plan as citizens of the world."

The world cannot live in peace without an equitable distribution of raw materials, he explained, and every nation must consider its economy as part of world's economy.

Speaking about a shortage of ores, Krug said petroleum might be included in the so-called depleted group as "oil fields have failed to replace depleted reserves." The secretary praised the A.P.I. and A.G.A. for their survey of proved crude and natural-gas reserves, adding that other major mineral industries would serve nation by doing likewise.

Southwest Production Meeting to Be Next Week

WATER - FLOODING operations, hard-rock drilling, and the use of plastics in well completions and remedial work are among the subjects which will be discussed at the spring meeting of the southwestern district of the American Petroleum Institute's Production Division March 27-28 in Fort Worth.

The meeting will be held in the Blackstone Hotel. Registration opens at 8 a.m. March 27; committee meetings are scheduled at 9 a.m. with the general sessions getting under way that afternoon.

The program follows:

THURSDAY, MARCH 27

Opening Sessions, 2 p.m.—Presiding: W. V. Vietti, The Texas Co., Houston, and B. J. Dowd, Union Producing Co., Shreveport. Remarks by Jake L. Hamon, Dallas, vice president, A.P.I. Division of Production; "A Progressive Public Relations Program for the Oil Industry," Ralph Champlin, director of public relations, Ethyl Corp., New York; "The Natural Gas Act and the Oil and Gas Producer," Walace Hawkins, vice president and general counsel, Magnolia Petroleum Co., Dallas; motion picture—"Drilling Operations in the Gulf of Mexico," courtesy of Magnolia Petroleum Co.

Banquet, 6:30 p.m.—Reception 6:30 p.m.; banquet 7:30 p.m.; no addresses scheduled.

FRIDAY, MARCH 28

Breakfast, 8 a.m.—All speakers and presiding officers for Friday sessions.

Morning session, 9:30 a.m.—Presiding: T. W. Rhoads, Gulf Oil Corp., Fort Worth, and George H. Fancher, University of Texas, Austin. "Case History of Water Flooding in Throckmorton County, Texas," Paul C. Dean, Dean Brothers, Fort Worth; "Inventory of Gas-Drive Operations in North Texas, West Texas, and New Mexico," Lee Flood, Goldsmith Pool Engineering Committee, Midland, Tex., and L. F. Peterson, Stanolind Oil & Gas Co.; "The Flow Properties of Drilling Muds," R. W. Beck, Creole Petroleum Corp., and W. F. Nuss and T. H. Dunn, Stanolind Oil & Gas Co., Tulsa; report of nominating committee.

Afternoon Session, 2 p.m.—Presiding: D. L. Harlan, The Texas Co., Fort Worth, and C. W. Faris, Shell Oil Co., Inc., Midland, Tex. "New Developments in Diamond Coring," R. W. Stuart, Stanolind Oil & Gas Co., Fort Worth; "Hard-Rock Drilling in West Texas," David Johnston, Humble Oil & Refining Co., Midland, Tex.; "Packer Problems in West Texas," T. H. Dwyer, Shell Oil Co., Inc., Midland, Tex.; "Well Completion and Remedial Work With Plastics," A. A. Townsend, Dowell, Incorporated, Shreveport, La., and Ralph Smith, Dowell, Incorporated, Houston.

Dinner, 6 p.m. (Fort Worth Club)—Honoring all speakers and district and chapter officers, W. V. Vietti, presiding.

Prominent in the organization handling details of next week's meeting of the southwestern district, A.P.I. Division of Production, are these three individuals: W. V. Vietti, chief petroleum engineer, The Texas Co., who is chairman of the southwestern district; R. B. Kelly, general manager, Texas producing division, Pure Oil Co., chairman of the general arrangements committee; and B. J. Dowd, supervising production engineer, Union Producing Co., Shreveport, chairman of the program committee

DIGESTS

A.I.M.E. ANNIVERSARY CONFERENCE PAPERS

Radioactive Markers in Oil-Field Practice

H. G. DOLL and H. F. SCHWEDE, Schlumberger Well Surveying Corp., Houston.

THE increased need for better depth discrimination, particularly for the deeper horizons, may be satisfied through the use of radioactive markers placed at chosen points in the wall of the bore hole with respect to known strata.

Successful apparatus for the detection of such radioactive markers has been designed to be lowered in the bore hole and withstand the highest temperatures and pressures encountered. The operation of the apparatus is safe, reliable, and does not require any appreciable rig time.

Radioctive markers assist the production engineer in the solution of problems involving depth measurement met during testing, production and remedial workover jobs. These markers, being placed in a known relationship to a given geological horizon, permit the accurate positioning of tools in the cased well with respect to formations previously located by an electrical log, regardless of the depth of the formations from the surface.

The increase in depth accuracy, provided by the use of markers, opens new possibilities with regard to the production of thin sections from which oil could not have been obtained by previous technique without great difficulty and expense.

Radioactive markers in the borehole become part of the well record as primary reference points for future production problems throughout the history of a well, regardless of changes in reference points with respect to surface equipment.

A Meter for Measuring the Distribution of Gas Flow in Well Bores

F. MORGAN and D. W. REED, Gulf Research & Development Corp., Pittsburgh, and L. L. GRAY, Gulf Oil Corp., Tulsa.

A FLOWMETER has been developed at Gulf Research & Development Corp. and tested in the field for measuring the flow of gas into well bores. It has been used in a study of the injection capacity of different horizons in gas-injection wells in Oklahoma.

The flow-sensitive element of the meter is a semiconductor having a very high-temperature coefficient of resistance. One of the advantages possessed by this meter is due to that property and the high specific resistance of the element.

In the application described here the element is heated to a temperature considerably above ambient by an electric current, which is supplied by a voltage source at the surface. When fluid flows through the meter the rate of dissipation of heat is increased and the temperature of the element decreases. Due to the negative temperature characteristics of the resistance element such a decrease of temperature will be accompanied by an increase of resistance which, under flow conditions ordinarily found in wells, is of such a magnitude that it can be directly measured or recorded in terms of a change in voltage at the surface.

In practice, rate of flow is measured in terms of the drop in voltage in the resistance element. All the metering and control apparatus remains at the surface while the thermal element is lowered into the well on a single conductor cable, consisting of an insulated wire and sheath. The meter is calibrated by passing known quantities of gas through it either at the surface or in the hole at a point immediately above the region in which gas is lost to the formation. In case calibration is made at the surface, the ambient temperature in the hole may readily be obtained by a second resistance element which is operated at a current so low that effectively no heating occurs.

The instrument is readily adapted to continuous recording, but the velocity of the meter relative to that of the gas must be low unless corrections are made. Curves giving data obtained in actual field tests will be shown. The meter can also be used to determine the distribution of flow capacity in a gas-producing well.

A differential form of the meter has been designed and built in which the local flow or injection capacity of the formation is obtained directly.

Use of Oil-Emulsion Mud in the Sivells Bend Field

W. H. ECHOLS, Standard Oil Co. of Texas, Gainesville, Tex.

AN oil-emulsion mud, consisting of a mixture of oil-base mud and bentonite water-base mud, has been used experimentally in drilling 8 of the 35 wells in the Sivells Bend field, Cooke County, Texas. Experience indicates the oil-emulsion mud can be controlled in much the same manner as a water-base mud, and the "drilling" functions of the two types of mud are comparable. The average water loss for the oil-emulsion mud was 3.8 cc. per well. When using oil-emulsion mud to drill the last 2,000 ft. of 7,000-ft. wells, the mud costs were approximately 2½ times that of water-base mud.

There are no data or observations to indicate that the use of oil-emulsion mud in the Sivells Bend field has contributed toward any improvement in the productivity of the wells in which it was used. That there were no discernible benefits, may be attributable to one of these reasons: (1) infiltration of fluids into the sands while drilling may have been of no consequence, since the sand permeabilities were sufficiently high as to permit the infiltered fluids to be flushed from the sands once the wells were placed on production, or (2) the magnitude of the water-loss of a mud may not be the controlling factor, but the presence of any degree of water-loss will just as effectively result in "blocking" sands within certain ranges of permeabilities and pressures.

Most of the apparent advantages gained through the use of oil-emulsion mud were related to actual drilling operations, in increasing drilling time and bit footage and the indicated longer service from drill pipe. However, it does not appear that these benefits justify the additional cost of the mud.

It is not believed that the use of oil-emulsion mud should be condemned solely on the apparent lack of application in the Sivells Bend field. It is believed that additional experience must be gained in controlling oil-emulsion mud so the resulting cost may be lowered to the point that its use is more easily justified. Additional research and development might disclose that this mud has many practical applications. The use of oil-emulsion mud might have application where certain types of heaving or sloughing shales create difficult drilling problems, since caliper logs indicate the well bore stands up exceptionally well through shale sections.

A Well Flow Meter for Logging Producing Ability of Gas Sands

R. P. VINCENT and R. M. LEIBROCK, Stanolind Oil & Gas Co., and C. W. ZIEMER, Barnsdall Oil Co., Tulsa.

THE well flow meter, which employs a hot wire anemometer connected in a Wheatstone bridge circuit, has proved particularly useful for determining the relative productive ability of individual sand members of gas wells. The successful operation of this instrument in measuring gas velocities in the well bore above each producing member has provided both a direct and accurate means of analyzing reservoir performance.

Results of tests conducted with the well flow meter in the Hugoton gas field of western Kansas have indicated some rather unusual production characteristics. In two cases it was found that all or the greater part of the total gas produced was coming from one section in wells where four "pay" sections have been perforated individually. These actual measurements contradict in many instances the indications of data obtained from electric logs and from core analysis; the fact that these latter sources often give highly incorrect results, demonstrates the necessity of a method, such as is provided by the well flow meter, for accurately determining the amount of gas coming from each producing member.

A Reservoir Study of the West Edmond Hunton Pool, Oklahoma

DR. MAX LITTLEFIELD, L. L. GRAY and A. C. GODBOLD, Gulf Oil Corp., Tulsa.

THE most significant phase of this study concerns the special type of geological core examination that was made in an effort to ascertain the type and degree of porosity in the rock in accordance with lithologic types. Results of this geological study showed the West Edmond pool to be of such complex nature as to appreciably affect the behavior normally associated with homogeneous reservoirs. Recognition of this condition in the reservoir essentially eliminates the prediction of performance histories by rigorous calculation, thus no predictions of gas-oil ratio and bottom-hole pressure behavior are made.

From volumetric calculations it is estimated that approximately 600 million barrels of stock-tank oil were originally in place in the West Edmond pool, and that fractures contained about 60 million barrels of this total. It should be anticipated that the percentage of oil recovery from the fracture system will be high because the fractures serve as good channels for gravity drainage. On the other hand, it is anticipated that the per cent oil recovery from the intergranular porosity will be relatively small. Estimating that 70 per cent will be recovered from the fractures, and that the intergranular recovery will be limited by a final free gas saturation of 32 per cent at 200 psi. reservoir depletion pressure in the intergranular porosity, the ultimate recovery for the West Edmond pool is estimated to be on the order of 165 million barrels by primary methods of operation. Although some economic benefit could probably be realized by unitized operation of the reservoir, permitting selective well production, it is not believed the injection of gas into a reservoir such as this could materially increase the ultimate recovery. With such a wide difference between permeabilities of the frac-

ture system and the intergranular system, and assuming good communication throughout the fracture system, it seems logical that gas injected into the reservoir would be recycled through the fractures at considerable expense without contributing much toward additional oil recovery.

The Quantitative Valuation of Methods of Procedure in Water-Flood Oil Production

HARRY M. RYDER, consulting petroleum engineer, Washington, D. C.

APPLICABLE to water-flood oil production, a method is presented for the determination of the effect of a change in operating procedure on the quantity of oil produced following that change. Evidence from the field and some theoretical considerations are offered in support of the validity of the method. Some limitations of the method are discussed. Examples are given of the use of the method as applied to the effects on oil production of increases in water pressure, of the changing of producing wells from pumping to flowing and of the chemical treatment of intake wells and supply water.

Conclusions

1. In the case of many carefully operated water-flood oil properties, the oil-production-rate decline curve follows the form: $P = A\,t^{b}$.

2. Because of this fact, selected curves can be competently extrapolated for the purpose of operational analysis.

3. This procedure makes possible the quantitative determination of the effect on water-flood oil production of a change in an operating procedure.

4. By the application of this method to existing water-flood oil-productibn data it has been possible to determine the effect on the quantity of oil to be ultimately produced from specific properties as a result of:

(a) An increase in water pressure.
(b) Changing producing wells from pumping to flowing.
(c) Chemical treatment of supply water and intake wells.
(d) Reshooting a well.
(e) Adding or removing certain wells.
(f) Interruption of operations.
(g) Other controllable factors.

5. The method proves that the quantity of oil produced from a specific property may be more or less, depending on the operating procedure. It therefore is a tool for increasing oil production.

6. The application of the method to an extended study of existing oil-production data would make possible the determination of the development and operating specifications for the most effective water-flooding of an oil property.

Oil Base Drilling Fluids

GEORGE MILLER, Oil Base, Inc., Los Angeles.

OIL-BASE drilling fluids are used mainly for drilling or coring the producing zones of oil or gas wells to obtain maximum productivity. If the proper material and supervision are used for this type of well completion, the results obtained will be completely satisfactory.

In recent months many new procedures have been discovered in regard to the manufacture and use of oil-base drilling fluids. It is the object of this paper to explain the hows and whys of oil-base muds and to reveal the advances of the various service companies and equipment manufacturers in connection with oil-base mud.

To obtain the maximum productivity from oil or gas wells the producing zones should be drilled or cored with a good oil-base mud so that these zones of production will not be water blocked or mudded off.

In order thoroughly to receive the optimum possible properties to be made from the proper materials and mixed with the correct type of oil for its base.

With proper supervision and cooperation, wells can be completed with oil-base mud for little more actual cost than is involved with conventional water-base muds. Even though the cost of oil-base mud was much higher than it now is, results show that this cost would be warranted in many cases.

Some Uses and Limitations Of Model Studies in Cycling

D. L. MARSHALL and L. R. OLIVER, The Texas Co.

THE use of model studies for the development of invasion patterns for cycling is illustrated by model studies obtained with a recently developed apparatus in the solution of actual cycling problems.

Model studies are of great benefit in the design and direction of a cycling operation. Each reservoir offers an individual problem and, as such, demands an individual solution.

The accuracy with which model studies can depict the course of cycling in any reservoir is limited by: (1) The accuracy with which the configuration of a reservoir and its pay thickness, porosity, interstitial water, permeability, and fluid content of its component parts (if there be more than one) are known, and (2) the accuracy with which production from an injection into the reservoir, of any section thereof, is known.

In some instances where a model study has not been made or is not warranted, cycling can be cautiously undertaken by making all possible use of production data and the background of experience gained elsewhere. Under such conditions it is virtually impossible to predict invasion patterns or to integrate an entire cycling program, and recoveries may be expected to be lower than in a completely planned and controlled operation.

Significance of World Petroleum Production Trends

WARREN L. BAKER and L. J. LOGAN, Oil Weekly, Houston.

RECENT announcements of plans for expanding petroleum facilities in the Middle East and Venezuela foreshadow an unusually sharp increase in foreign production in the immediate future. Therefore, the next few years will bring far-reaching changes in world petroleum affairs, with foreign petroleum production and other activities assuming much greater importance than formerly.

Tabulation of figures on development already under way or planned indicates that in the next several years facilities will be available for producing, transporting and refining twice the prewar production of foreign fields and about 50 per cent or nearly 1,500,000 bbl. a day above their record-level output of 1946.

The foreign expansion of the petroleum industry holds favorable implications for American engineers and technologists, confronting them with broader horizons and increased responsibilities both at home and abroad.

Potentiometric Model Studies

B. D. LEE, The Texas Co., Houston.

A SIMPLIFICATION of the method of Hurst and McCarty for conducting potentiometric model studies is presented along with experimentally determined invasion patterns for certain idealized flow problems. The analytical solution for one class of these problems is given. Finally, a general description is given of a newly developed instrument which permits direct mapping of flow lines and determination of transit times in potentiometric model studies.

Evaluation of Gas Condensate Reservoirs for Cycling

WILLIAM H. JUSTICE, Tide Water Associated Oil Co., Houston.

THE evaluation of gas-condensate reservoirs is a current problem with the oil industry. A greater percentage of the reservoirs being discovered today by deeper drilling contain fluids of this type so that they are becoming of ever greater economical importance to the oil industry.

The following physical properties of the reservoir should be determined as soon as possible after discovery.

1. Determine the thickness of each producing sand.

2. The porosity and permeability of the pay by complete core analysis of all the productive sand.

3. Determination of flow characteristics of the wells by flow test at various rates to determine the optimum rate at which the wells can be produced.

4. Estimate the connate water in the reservoir by core analysis and from the electric logs.

5. Accurately determine the bottom-hole pressure and temperature of each reservoir with a conventional bottom-hole pressure gage.

6. Define limits of reservoir by the drilling of sufficient exploratory wells and by the study of the geophysical data for the area.

7. Locate and determine the throw of any faults cutting the reservoir by study of the well logs, geophysical data and surface geology.

8. Using the physical properties listed above estimate the initial volume of gas in the reservoir. This estimate is usually made using the porosity-acre feet method or if sufficient production history of the field is available the pressure-volume method may be used as a check for the first estimate.

The size of the reservoir is an important factor in the decision of the most economical method of producing this type of reserves. It is obvious that regardless of the retrograde characteristics of the gas if the reservoir is very small it would be uneconomical to cycle the gas since the field development and cycling plant cost would be greater than the value of the increased recovery of condensate.

In a few reservoirs the natural water drive may be active enough to maintain the reservoir pressure with an economical production rate of gas and condensate.

It may not be economically advisable to cycle reservoirs of this type where the gas can be processed in an efficient condensate recovery plant and the residue gas marketed or returned as make-up gas to another reservoir that is being cycled.

Difference in Recovery of Condensate in Field Separator and Modern Recovery Plant

The recovery of condensate by cycling as compared to the volume recovered by straight production is not only the difference in recovery due to retrograde condensate but in addition usually involves the difference in recovery of condensate in the field separator and the recovery in a modern extraction plant. The sales demand from most gas reserves is so variable that it is usually not economical to install an extraction plant for the sole purpose of processing the sales gas so that the gas from reservoirs that are not cycled are often not processed in an efficient extraction plant. The recovery of condensate in a field separator is only approximately 50 per cent of the total condensate recovered in a modern recovery plant. Usually the condensate recov-

(Continued on page 326)

WASHINGTON WATCHING

BY HENRY D. RALPH

A Familiar Pattern

WASHINGTON. — Fortunately for President Truman's program for aiding Greece and Turkey no American oil company has producing concessions in those countries, but even so oil is entering into the discussion.

Already the left-wing press is screaming that the whole progrem is nothing but a scheme to protect "Standard Oil" investments in the Middle East. A prima facie case can be made for this argument only by starting with an assumption which the left-wingers themselves reject, that is, that unless Russian aggression (perhaps "influence" a more diplomatic word) is halted in that part of the world it may spread to the Indian Ocean and result in local governments hostile to American interests of all kinds, oil and otherwise.

It is unrealistic to pretend that American commercial enterprises in the Middle East do not influence the Government's new foreign policy, but it is crass and false to say that our concern for democracy and humanitarian rights is nothing but a screen for dollar diplomacy.

It has not yet been determined what tack will be taken by congressional critics of the Greek-aid proposal, but it would not be surprising if an investigation of Middle East oil should develop as a byproduct of it or of the Anglo-American petroleum treaty.

In addition to a natural desire to learn just what is our stake in Middle East oil, a good many rumors and insinuations are being whispered around Washington. Some of these originate with former employes or officials of Arabian American Oil Co. or its parent companies, but sooner or later they might be echoed in the Capitol.

These inuendoes could easily be dragged into the public debate on our latest turn in foreign policy.

Treaty Hearings

HEARINGS on the Anglo-American petroleum treaty have been indefinitely postponed because the Senate committee on foreign relations is devoting its entire attention to President Truman's request for financial and other aid to Greece and Turkey.

This subject may take at least until the end of this month, and then the committee may wish to take up one or two other matters before turning to the oil agreement. The State Department, however, intends to keep pressing for consideration of the treaty at this session. With the Senate's attention focused on the Near and Middle East as a result of the Greek crisis, the petroleum agreement takes on additional interest, and the hearings may be more than routine.

Reversal of Policy?

A REVERSAL of policy appears to have taken place within the Federal Power Commission on the matter of its jurisdiction over production and gathering of natural gas prior to its introduction into an interstate transmission line.

In several recent decisions, most notable that involving the Interstate Natural Gas Co., Inc., the commission has reached farther and farther toward ultimate regulation of production and gathering of natural gas and sales for interstate transportation. But the FPC staff last week issued a report saying that the law clearly gives the commission no such jurisdiction.

This shift in position may be more apparent than real—from two points of view. One view is that the commission is afraid of a spanking from Congress or the courts and is pulling in its neck for the time being in hopes that the opposition will subside after while and it can then proceed with its attrition of the statute. The other view—the one taken by the FPC staff—is that the commission only appeared to be reaching for control of production and that its decisions in the Interstate and similar cases are not as far-reaching as the industry thinks.

Wording Troublesome

In support of this explanation—or alibi—the staff report declared that the facts in the Interstate case were most unusual and not at all typical of the gas business. Also, that in this and other cases discussed the decisions, as related to the facts in issue, are not out of line with the intent of Congress. The trouble, it is asserted, comes from language in FPC and court opinions which can be interpreted as giving the decisions wider effect than they actually have and which suggest that power to regulate field prices in some instances might be extended to all production and gathering.

The issue, the report says, is whether a sale at the conclusion of production and gathering gas is a sale for resale in interstate commerce within the meaning of the act, notwithstanding the statutory exemption with respect to "the production and gathering of natural gas." It assumes that Congress would have power to regulate the sale of gas in the field for the purpose of movement in interstate commerce but concludes unequivocally that Congress did not include such sales under the jurisdiction of the Natural Gas Act.

The staff reached this conclusion by an analysis of the language of the act and the nature of the gas business, but more particularly from a study of the intent of Congress as revealed in committee hearings and debates in the House and Senate when it was under consideration.

The report declared that there is no justification for language in certain opinions which appears to distinguish between price control over production and gathering and the regulation of physical facilities used in performing these functions. The conclusion is that both are outside FPC jurisdiction.

However, the report is discussing only arm's length transactions, where there is no interlocking interest between the producer selling the gas and the pipe line buying it. A later section of the report will discuss the extent of FPC jurisdiction over production and gathering done by interstate pipe-line companies themselves or by their affiliated corporations.

It also said FPC should have power to determine its own jurisdiction in borderline cases where a finding of facts is necessary to decide whether or not a given production and gathering operation is subject to regulation. It is this reservation of authority which has raised doubts among the commission's critics.

The State's Province

THE view that conservation of natural gas is traditionally and properly a matter for state control is accepted and even endorsed by the staff of the Federal Power Commission in its report on the natural-gas investigation. It recommended that the commission keep in mind the problems and functioning of state conservation authorities in all of its regulation of interstate transmission and rate fixing.

While declaring that the states have had varying success in their conservation efforts, the report concludes that there is no need to disturb their authority, and that from a practical viewpoint it is highly desirable that

problems of conservation and correlative property rights be dealt with locally.

However, some observers profess to see a threat of future federal regulation in a statement that the states should meet their responsibility by positive action, particularly to stop the waste of casing-head gas from oil wells. On this point the staff suggested:

"It should be the determination of the producing states within the early future—3 years at most—to eradicate every significant instance of gas wastage into the air. The one sure way to accomplish this objective is to outlaw such practices and to place the burden of seeking exemption upon the producers responsible for blowing the gas. It is suggested, therefore, that producing states, wherein flaring now occurs, seriously consider the enactment of legislation prohibiting under severe penalties any flaring of casing-head gas except as specifically and temporarily authorized by state commission order."

"Staff Reports" Clarified

THE "staff reports" currently being issued by the Federal Power Commission on the scope of the Natural Gas Act are interesting and important, but they are not conclusive.

They represent the views of a group of employes—engineers, attorneys, and economists — assigned to digest the evidence submitted at the lengthy hearings and draft tentative conclusions for further discussion. After interested parties have submitted comments the five commissioners—the men who make the policies—will issue a final, official, report.

This device of a "proposed report" or an "examiner's recommendation" is used by several federal regulatory agencies, and is frequently followed by the filing of briefs or oral argument. It defines the issues and gives affected parties a chance to object to specific points. More often than not the staff report becomes the final ruling, in major outline at least, but this does not always follow. However, men assigned to write staff reports are usually pretty well informed on the policies of the heads of their agencies, and they are not prone to make findings which are likely to be overturned. Also, the agency heads usually have confidence in their staff and support their recommendations unless an interested party can make out a good case that the findings are contrary to the law or to the evidence.

The term "staff report" has been given a technical meaning by the recently enacted administrative procedure act. This requires every regulatory agency to publish in tentative or proposed form every new rule or regulation prior to its official promulgation. This is so affected industries or individuals will have an opportunity to protest before the rule takes effect, and usually the proposed regulation is accompanied by a staff report summarizing the reasons for the new rule.

These FPC staff reports on the natural-gas investigation are not the type required by the Administrative Procedures Act, but are issued only for the information of the industry and to give the commission the benefit of all pertinent comments before the final report is drafted.

The Investigation's Results

SO far the FPC has issued five sections of its report on the natural-gas investigation (four last week on production and one on service areas some weeks ago). None of these has contained anything particularly hostile to the gas industry nor to state regulation. In fact, much in these reports restates the position of the industry with approval.

Much more of the report must be issued before final judgment can be passed, and it is still a staff report subject to change by the commissioners themselves. But so far it has proved that the natural-gas investigation, contrary to the industry's fears at the beginning, has been quite valuable in collecting pertinent facts and clarifying muddled thinking on the part of federal and state regulatory agencies and the industry itself.

Conservation of natural gas is important to the general public and there has been much confusion of thought as to the proper role of the federal Government and of the state commissions. The FPC report so far is steering firmly away from extension of federal power into this field. There is a real appreciation of the practical problems involved in local regulation of oil and gas production and of the efforts and progress being made by the states and the industry in preventing gas wastage.

Completion of the report, coincident with clarifying amendments to the Natural Gas Act, should remove the doubts and fears which have been hanging over the gas industry and open the way to a healthy and vigorous expansion.

An Undiminished Need

THE need for legislation defining the jurisdiction and authority of the Federal Power Commission is increased, rather than made unnecessary, by the Federal Power Commission staff report on production and gathering, in the opinion of Rep. Ross Rizley of Oklahoma, one of the sponsors of such legislation.

In its recent report, the FPC staff concluded, on the basis of evidence presented at the natural-gas investigation (Docket G-580), that the commission has no jurisdiction over production and gathering prior to interstate transmission. It recommended that the commission make an administrative ruling to this effect and thus obviate the need for congressional action.

Rizley disagrees. He told the House last week:

"Such disclaimer would not now be necessary had the commission followed the clear intent of Congress as expressed in the Natural Gas Act. . . . The staff report admits that Congress never intended that the FPC have jurisdiction over production and gathering, but the same report likewise reveals that the commission has in the past reached out and taken jurisdiction in questionable cases.

"A reading of this FPC document certainly confirms the fact that Congress must specifically define the area in which the FPC may operate.

"Assuming that the present members of the FPC understand this matter thoroughly and will seek to carry out and construe the act as Congress originally intended that they should, who can say with any certainty how long the present members of the commission will continue to serve?

Rizley pointed out that in the so-called Interstate case, now on appeal to the Supreme Court, the FPC had an opportunity to acknowledge its limitations with respect to production and gathering but instead it interpreted the law as giving it authority over gas production. He argued that this puts FPC in an untennable position: either it should enforce its interpretation of the law against all producers and gatherers or else it should not oppose legislation to deny such jurisdiction.

Pipe-Requirements Survey

A SURVEY of the steel requirements of all proposed "big inch" oil and gas pipe-line projects is being made by a subcommittee of the interdepartmental petroleum committee. Representatives of the Oil and Gas Division, Federal Power Commission, Department of Commerce, and Civilian Production Administration will attempt to ascertain how much pipe will be required for all projects, both foreign and domestic, which will use 500 tons or more of pipe 12 in. or larger in diameter.

It has not yet been decided just what use will be made of the figures, since the priorities and allocation system is no longer in effect, but it was felt that the large number of pipeline projects being discussed will put heavy demands on the few rolling mills capable of producing such pipe, and that a compilation of the prospective orders would assist the mills and the pipe line contractors in orderly scheduling.

Product Prices Up Generally 1 Cent Following Crude Advance

PETROLEUM products prices in the Mid-Continent and Midwestern areas appeared to be leveling off early this week at postings approximately 1 cent above those prevailing before the March 10 crude-oil advance.

A week of steadily rising tank-car prices following the crude-increase announcement was marked by reluctance of suppliers to give quotations until the market had reached its apparent maximum. Tank-car motor fuel was reported moving at around 8 cents, Group 3, in contrast to 7-7¼ cents prior to March 10. Small quantities of material at prices fractionally below 8 cents were said to be available.

Middle-grade burning oils were up generally ⅞ cent but marketing officials reported sales above top quotations in some cases. No. 2 was quoted at 6 to 6¼ cents, and 42-44 kerosene, 6¾ to 6⅞ cents. Quotations on residual ranged from $1.55 upward, and many industrial buyers were reported actively seeking the heavy fuel oil.

The advances in tank-wagon prices varied. Standard Oil Co. (Ind.), which initiated the general crude-oil advance, posted increases of ½ cent on all grades of gasoline, naphtha, and refined oil, including heater oil, furnace oil, and diesel fuel, except high-speed diesel fuel which was advanced 0.7 cent. Continental Oil Co. advanced tank-wagon prices ½ cent in Oklahoma and the Rocky Mountain area. Retail and tank-wagon prices of gasoline in Arkansas and Louisiana were increased 1 cent by Standard Oil Co. of Louisiana. Standard Oil Co. (Ohio) announced a 1½-cent retail increase in gasoline.

Extreme strength continued as the dominant note in products markets, despite the price advances. Interrefinery inquiries for motor fuel were frequent; heavy burning-oil demand remained beyond the usual end of the consuming season. Further increases in motor fuel quotations were considered likely when summer demand sets in. Lubricating oils, long one of the tightest products in the petroleum list, were actively sought with suppliers posting increases of several cents as a result of the crude raise.

In New York, further advances in East Coast gasoline were anticipated shortly. Residual continued tight with an advance also expected for this product. Kerosene prices continued firm, while No. 2, which has been weak in the East throughout the winter, was reported in better demand with a 0.2 cent price advance by Socony-Vacuum Oil Co., Inc.

Suman to Head Equipment Standardization Committee

NEW YORK.—John R. Suman, vice president of Standard Oil Co. (N. J.), has been appointed chairman of the American Petroleum Institute's central committee on standardization of oil-field equipment.

JOHN R. SUMAN

Suman succeeds the late J. Edgar Pew, chairman of the committee since its inception. In announcing the appointment, William R. Boyd, A.P.I. president, pointed out Suman had been one of Pew's chief assistants in the work of the committee.

Extra Copies of Color Section Available

THE following section of 32 pages shows flow charts and presents brief descriptions of 31 leading refining processes used in the modern refinery. One all-important factor in refining operations is automatic control, and the kind and location of the various controls are shown in color in these flow charts, to simplify and clarify the presentation of the processes. The foldout insert shows the flow of a typical refinery in which all major operations are carried out, whatever the individual types of processes may be. The tabulated list of petroleum products and their derivatives is excellent reference material.

A limited number of these 32-page sections, including the insert flow chart, is available at 1 dollar each, for those who desire it as a handy reference.

Leasing Regulations Amendments Approved

WASHINGTON. — Amendments to the oil and gas leasing regulations meeting most of the objections of the industry have been approved by the Interior Department.

The new rules contain a series of regulatory and interpretative provisions to make it clear that an individual may obtain the maximum acreage permitted by the law even though he is associated with others in a lease, to provide that the limitation on options does not include acreage under actual lease, and to clarify a number of other sections of which the industry complained.

DEATHS

Benjamin Howard Gray, 54, who retired early this year as president of Princeton Refining Corp., Princeton, La., died March 9 at his home in Shreveport. Gray helped organize the Princeton company in 1940. Earlier, he was associated with Shrevport-El Dorado Pipeline Co. and had been vice president of Atlas Pipeline Co.

Lafayett DeVore, 79, former Wichita, Kans., oil operator, died March 9 in St. Louis.

James Ralph Ingram, 52, chief tank strapper for Interstate Oil Pipe Line Co., died March 9 at his home in Shreveport.

J. E. Fenn, president of Orange State Oil Co., Miami, Fla., died March 7 in Jacksonville, Fla.

Dan S. Brooks, former president of Root Petroleum Co., El Dorado, Ark., died March 7 in Indianapolis. Brooks resided in Shreveport until his retirement in 1941 when he moved to Indianapolis.

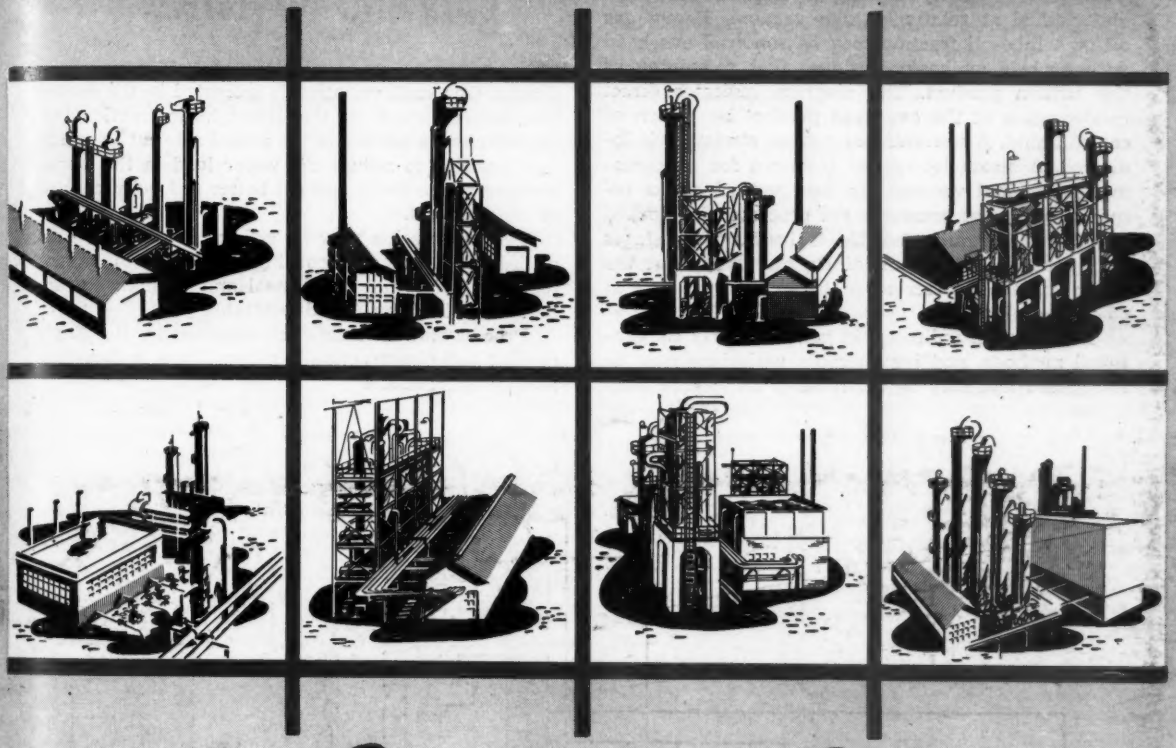
Perry W. Ward, 60, independent oil operator, died March 12 in Tulsa. A native of Topeka, Kans., Ward came to Tulsa in 1917.

Merle Dana, 53, Tulsa, assistant purchasing agent for Unit Rig & Equipment Co., died March 12 in Tulsa.

W. W. Allen, '78, San Antonio, founder and senior member of Allen & Morris Drilling Co., died March 9 in San Antonio. He was a pioneer driller in the Spindletop and Sour Lake fields. He entered the oil business in 1903 as a driller in Spindletop, and in 1923 organized the drilling company..

L. Fisher White, 51, oil man in Ohio for the past 25 years, died March 15 at his home in Columbus.

REFINING PROCESSES



AND THEIR *Automatic Control*

FEATURING: Thirty-one flow diagrams of modern processes, with descriptive data . . . foldout insert flow diagram of modern refinery processing, combined and correlated with a list of all the principal products obtainable from petroleum . . . exclusive annual plant survey of North American petroleum refineries . . . economic analyses of refining operations . . . specially prepared feature articles, on latest developments in petroleum techniques . . . in this special section of

THE OIL AND GAS JOURNAL

Atmospheric and Vacuum Distillation

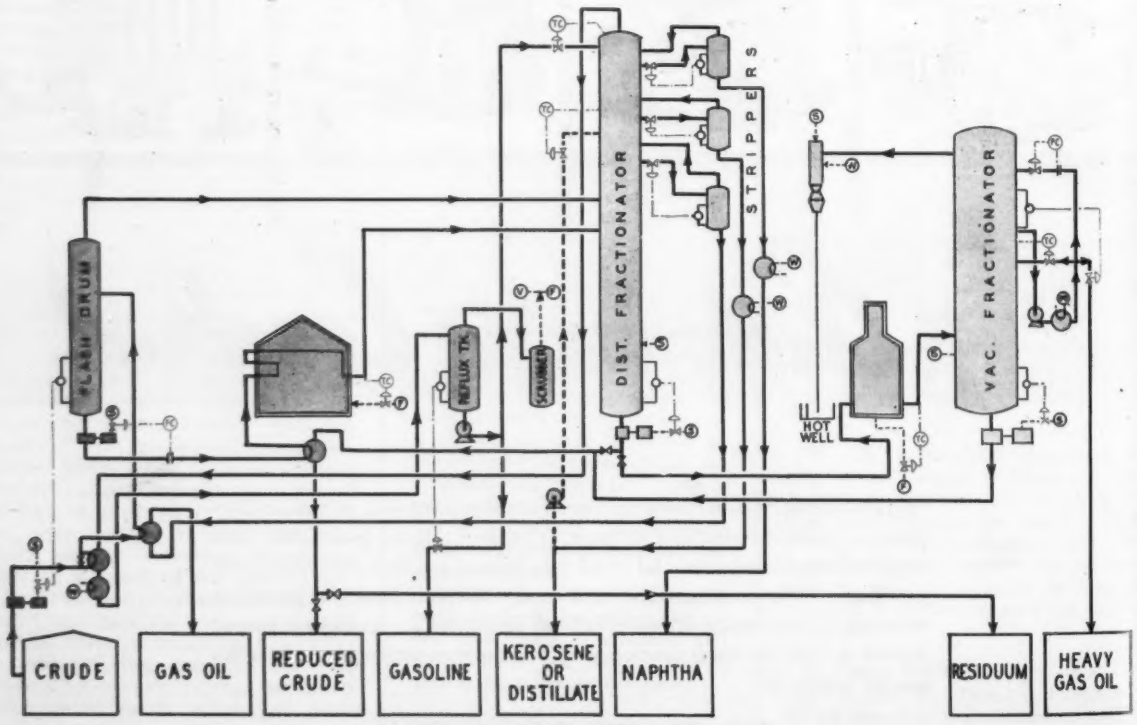
THE accompanying diagram shows the essential steps in the primary distillation of crude oil. The first step is the "skimming" or "topping" operation which is usually carried out at substantially atmospheric pressure. The crude is usually preheated by exchange with hot products leaving the unit, after which it is heated in a pipe still to the temperature necessary to secure the desired fractionation. From the pipe still the hot crude enters the fractionator. Gasoline or light naphtha is taken overhead while heavy naphtha, kerosene, burning oils, diesel fuel, and light gas oils may be removed as side streams. Strippers are usually employed on the side streams to vaporize and return to the tower the lightest portions of the withdrawn liquid.

The second step is the vacuum distillation of the bottoms from the atmospheric fractionator. These bottoms are usually heated in another tube still and flashed at relatively high vacuum. Heavy gas oil or a lube-oil fraction may be removed overhead with asphalt or heavy residual fuel remaining as the bottom product. The diagram indicates direct condensation of the overhead product by return of cooled liquid. A conventional surface condenser is indicated. A steam jet system is shown for maintaining the desired vacuum. In case several stocks requiring different pressures are processed in blocked operation it is quite feasible to install three stages for operation at 20 mm. of Hg and then shut the steam off the booster stage to secure operation at 65 mm. of Hg.

The diagram indicates, in general, fairly conventional methods, and innumerable variations may be introduced and may be desirable to fit specific conditions. One such variation is indicated in the dotted side reflux return on the atmospheric fractionator. By returning a portion of the cooled side cut as reflux it is possible to reduce the vapor load in the upper portions of the tower and get better end point control of the side cut.

Instrumentation may be either complete or simplified. The use of recording flow controllers for regulating side cut withdrawal and stripping steam quantities is often found desirable.

Process flow and data are supplied by the Engineering and Construction Division, Jones & Laughlin Supply Co., Tulsa.



Cycloversion

Catalytic Cracking

REFERENCE to the flow diagram shows that fresh feed is charged to the process furnace where it is preheated to enter the catalyst bed at 980°-1,030° F.

The catalyst chambers are operated at about 85 psig. and the reaction period "on stream" ranges from 2 to 10 hours when cracking gas oils and 24 to 36 hours when reforming naphthas and motor-fuel-range stocks.

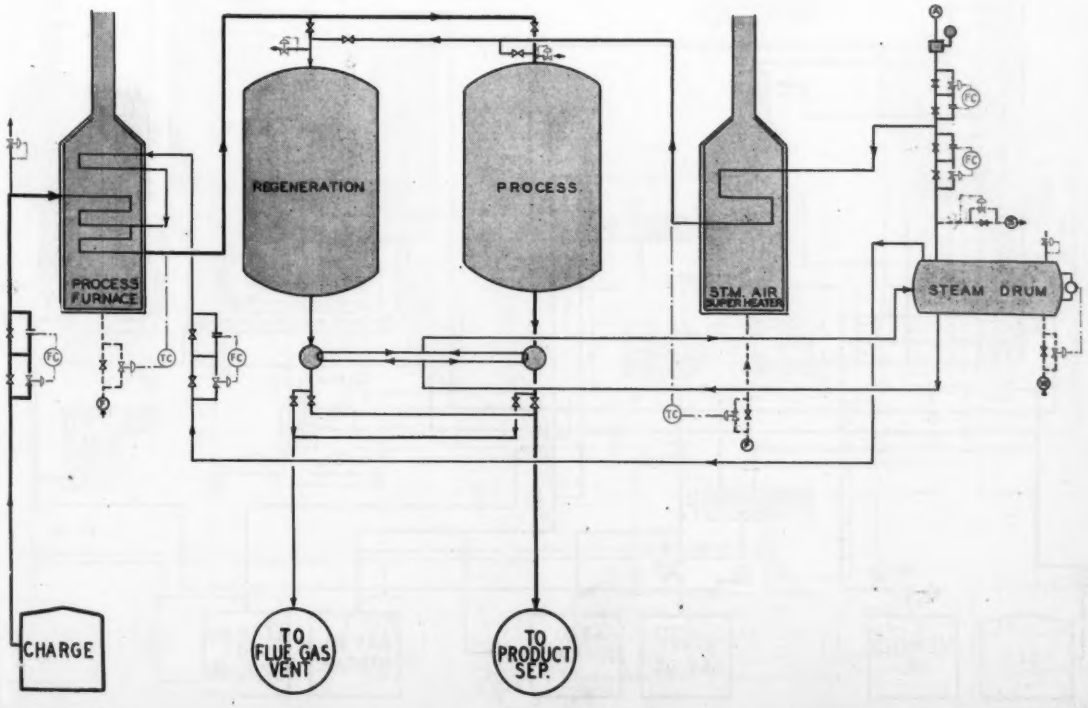
In regeneration steam is superheated to about 850° F., mixed with air and fed to the catalyst chamber. The temperature in the regeneration period is controlled at about 1,200°-1,400° F.

The principal control features of the Cycloversion process include a high-temperature alarm on the catalyst chambers and a carbon dioxide recorder on the spent regeneration gas. The high-temperature alarm is to warn the operator of excessive temperatures during regeneration and the carbon dioxide recorder is to follow the course of regeneration.

This process is licensed by Phillips Petroleum Co., Bartlesville, Okla.

CYCLOVERSION CATALYTIC REFORMING OPERATIONS

Crude source—	Illinois		Kansas		West Texas		West Texas	
Charge stock—	straightrun naphtha		straightrun gasoline		Blend cracked straightrun gasoline		straightrun naphtha	
Temperature, °F.	1,010		1,000		1,000		1,040	
Pressure, psig.	50		50		50		50	
Process period, hours	24		24		24		24	
Yields, Vol. % of charge:								
Catalytic gasoline, C_5-400 e.p.	93.85		88.23		89.80		85.23	
Butanes-butylenes	1.57		4.72		5.65		5.73	
	Charge	Catalytic gasoline	Charge	Catalytic gasoline	Charge	Catalytic gasoline	Charge	Catalytic gasoline
Research octane number	33.8	47.8	41.6	56.7	59.5	67.1	40.3	68.4
+1 cc. TEL	44.8	61.0	52.3	67.9	66.9	75.7	48.7	76.0
+3 cc. TEL	58.8	72.4	65.7	78.3	74.8	83.3	57.9	82.9



Fluid Catalytic Cracking

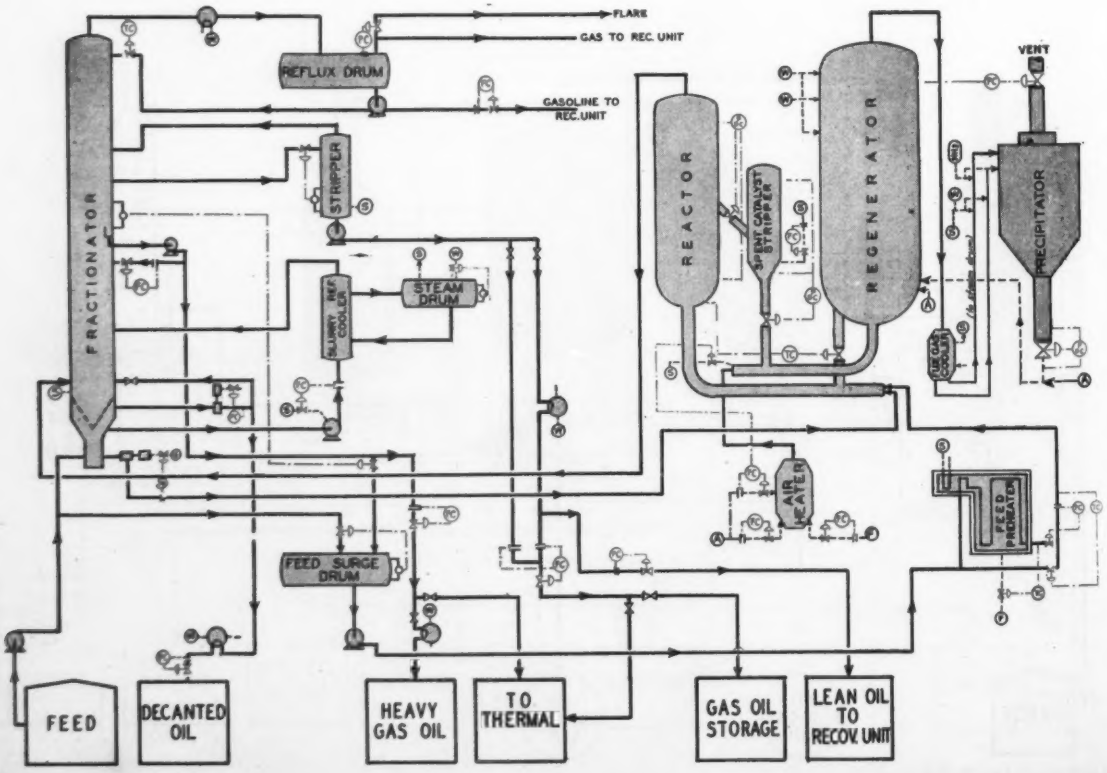
THIS process is the first to apply, on any considerable scale the principle of a "fluidized" catalyst. In the operation of this process a very finely divided catalyst such as silica - alumina, with particles of sizes up to 300 mesh, at elevated temperature, is picked up by a stream of charge-stock vapor and carried into the reaction chamber where the vapors are cracked while passing through a bed of catalyst. The cracked vapors pass through "cyclones" near the top of the reactor, devices which remove most of the entrained catalyst. The remainder of the catalyst fines is removed by electrical precipitators, known as "Cottrells," and all catalyst material is returned to the regenerator or to streams which carry it to that part of the cycle.

The cracked vapors are handled in much the same manner as are vapors from any cracking operation. The spent catalyst is regenerated continuously by blowing through the catalyst bed in the regenerator a stream of hot air-flue gas mixture in which the oxygen content is regulated so the carbon-burning process is prevented from developing too high temperature in the catalyst. Reaction temperatures may range from 800° to 1,000° F.; regeneration temperatures are held normally to little higher than about 1,125° F., though the latest practice may vary more widely than it did earlier.

Catalytically cracked gasoline from this and other catalytic processes shows a high percentage of aromatics throughout most of its boiling range. The octane rating and operating performance are high, and storage stability in properly refined products is good. Both once-through and recycle operations are employed, with gasoline yields from the first of 50 per cent or higher. Recycle operation may yield well above 60 per cent gasoline. Furnace and distillate fuels oils from catalytic cracking show better properties for most purposes than do fractions of similar range from thermal cracking.

Octane ratings of catalytic gasolines are higher than those of thermally cracked fuels.

This process is licensed by M. W. Kellogg Co., New York, and by Universal Oil Products Co., Chicago, Ill.



Houdry Catalytic Cracking

TEMPERATURE control in the reactors is maintained by the circulation of heat-transfer salt. The temperature of the salt entering the reactors may be varied by adjusting the rate of flow of a portion of the total salt stream to a boiler where excess heat is utilized in the generation of steam. As shown in the flow diagram, control valve, CV, is adjusted by remote control.

The reactor onstream pressure is maintained automatically by a conventional pressure controller which actuates a back pressure valve, located in the rich gas line from the gas and water separator of the synthetic crude tower overhead stream.

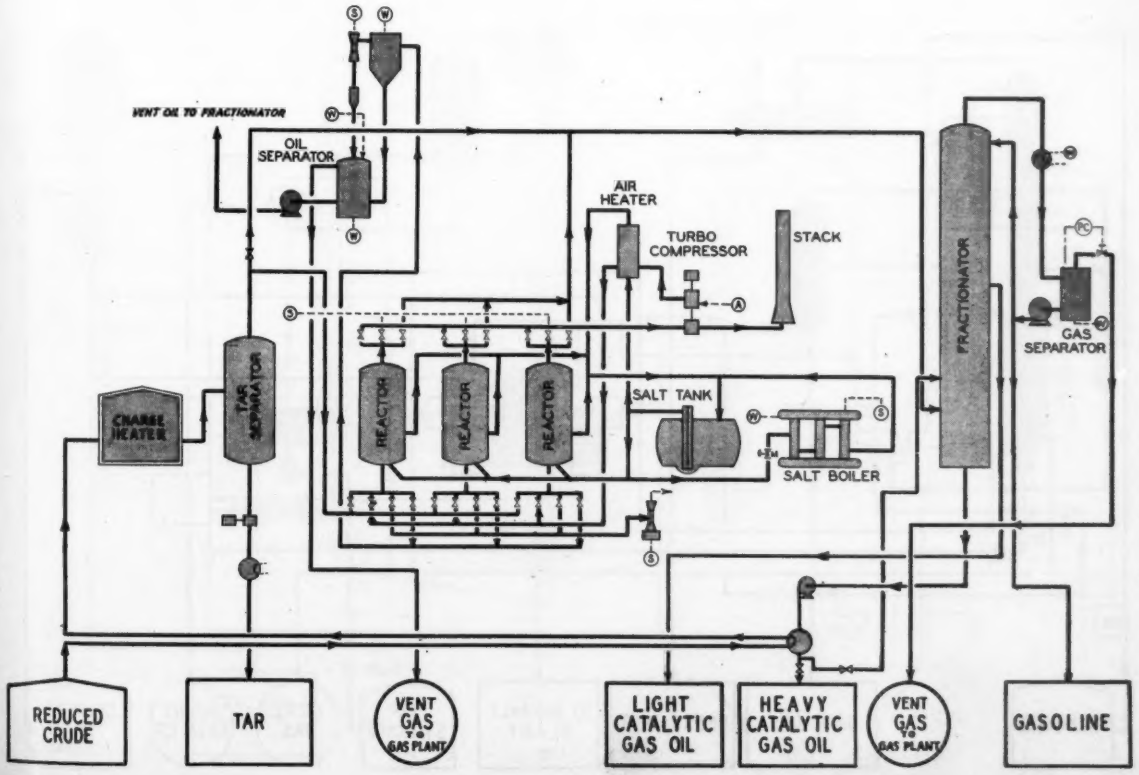
The most interesting control feature of the process is the regulation of the sequence of onstream, evacuation, and regeneration periods of each reactor according to a predetermined schedule by the movement of motor-operated valves actuated through an electrical cycle-timing device. The cycle-timer equipment, located in the main control room, is provided with a multiplicity of circuits and contact points so that practically an unlimited number of timing sequences can be set up.

Some of the cycle-timer circuits are used to open and close the various motor-operated valves on each reactor. In addition, a number of interlock and check circuits have been incorporated.

One of the check circuits which functions after all valve movements is that of testing for the position of each valve a few seconds after its opening or closing operation should have been completed. If a particular valve is not completely opened or closed at the time the check impulse is sent out from the cycle timer an alarm will sound in the control room and the cycle timer will stop.

Another group of safety controls are the valve interlock circuits which prevent the opening of certain valves on a reactor when other valves on that same reactor have not been completely closed.

This process is licensed by Houdry Process Corp., Philadelphia.



Suspensoid

Catalytic Cracking

THE Suspensoid process for catalytic cracking of petroleum fractions is based on the principle of mixing granular catalyst and charge stock, heating together, and removing the used catalyst from the heavy residue.

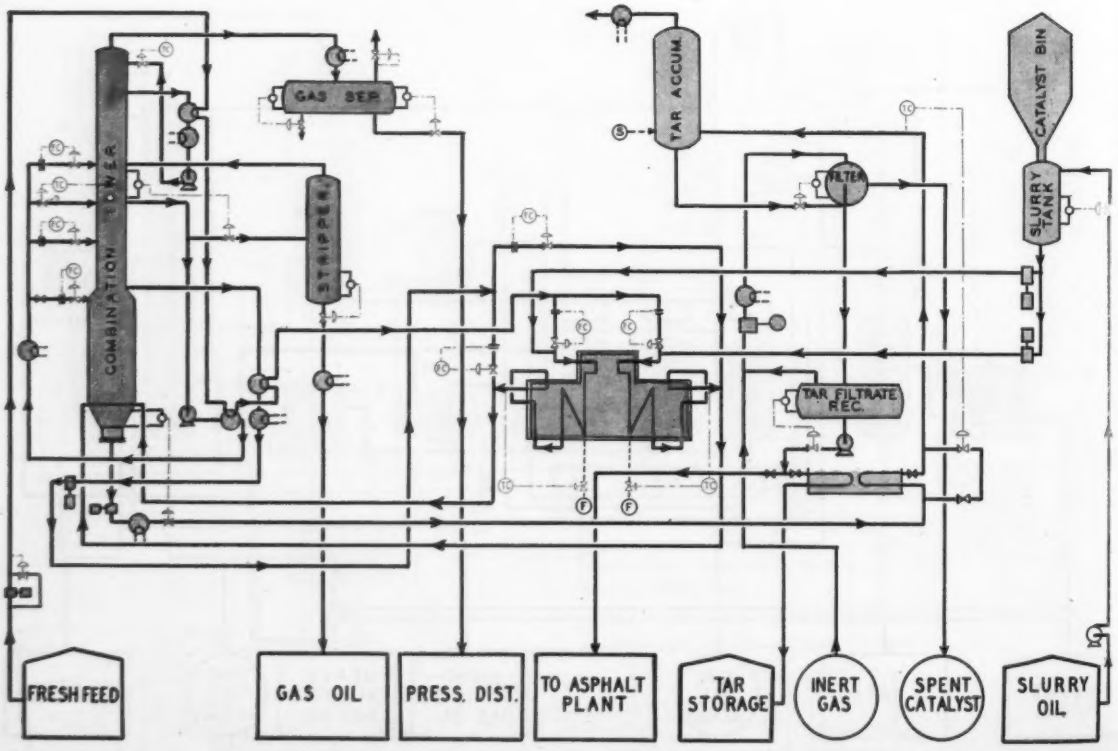
As practiced by Imperial Oil Co., Ltd., the granular catalyst which normally is of the clay type is mixed with a portion of the charge to form a slurry. This slurry is pumped to combine with the main body of the charge which may contain up to 25 per cent naphtha just before each enters the heater coils in the furnace, the main charge having been preheated previously, for example, in exchange with the outgoing heavy residue. After heating the mixture to 1,000°-1,050° F., for instance, and at pressures up to 400-500 psig., the charge is flashed in a chamber, after passing through a constricted nozzle or port, used to maintain the back pressure on the system. The flashed vapors pass to the fractionator, the heavy residue to a surge tower from which it is picked up by slurry pumps and sent at temperatures of the order of 500° F. to rotating filters, which remove the catalyst from the heavy oil, which is utilized as fuel oil, etc. The addition of naphtha to the charge is for the two-fold purpose of reducing viscosity and of aiding in the vaporization of the charge.

Insufficiently cracked oil from the bottom of the fractionator may be used as recycle or for any purpose for which similar products from thermal or other cracking processes are used. The overhead vapors are handled similarly to any cracked product. Any practicable proportion of catalyst may be employed, although commercial operations so far have been carried out mainly with 2 lb. of catalyst per barrel of charge stock.

This process is licensed by Imperial Oil Co., Ltd., Toronto, Canada.

YIELDS AND PROPERTIES OF SUSPENSOID CATALYTICALLY CRACKED MOTOR FUEL

Lb. 3A catalyst per bbl. feed	10	
Coil pressure, psig.	400	
Coil temperature, °F.	1,055	
Yields, volume per cent—	Excl. poly.	Incl. poly.
Gasoline, 400° F. e.p., 10 lb. R.v.p.	52.4	58.7
Excess butane	4.6	0
Heating oil, 415-600 V.T.	18.8	19.1
Fuel oil, over 600 V.T.	12.2	12.2
Dry gas, weight per cent	15.3	12.9
Octane No. clear, A.S.T.M.	75.4	77.4
Octane No. clear, Research	86.9	87.6



Thermofor Catalytic Cracking

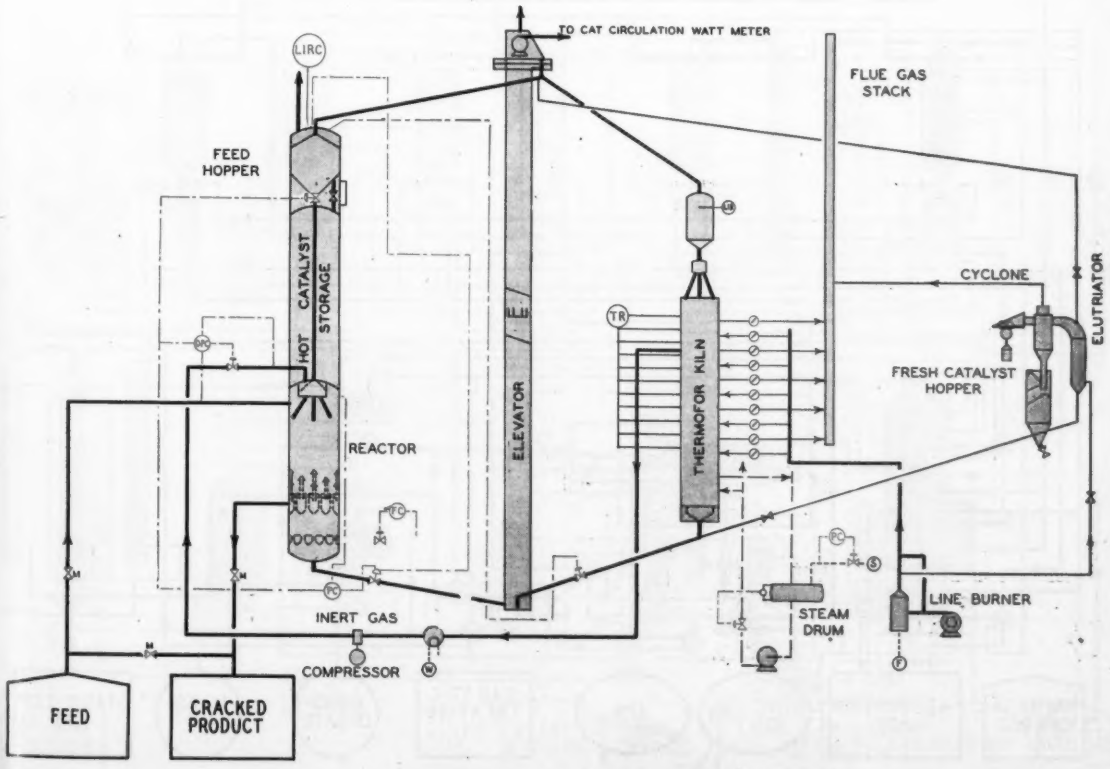
OF particular interest in the most recent T.C.C. design are two new commercially proven features: (1) Concurrent flow of oil and catalyst through the reactor, which results in better utilization of the heat of the catalyst and oil charge streams, and (2) the mixed-phase technique, which permits the T.C.C. cracking of partially vaporized oils.

The split bucket-type elevator shown here is used on the smaller units where catalyst requirements do not necessitate separate elevator installations for the spent and regenerated catalyst. The catalyst circulation is varied by changing the remote-controlled valve setting on the catalyst line from the kiln, thus varying the loading of the buckets. The hopper on top of the reactor receives regenerated catalyst from the elevator and provides surge capacity in the flow of catalyst to the reaction zone. The indicating level controller in the hopper throttles the chopper valve to regulate the catalyst flow from the bottom of the reactor. Spent catalyst from the reactor is discharged by the elevator into the kiln hopper which provides surge capacity for variations in catalyst flow rates. To assist in the control of catalyst flow, the hopper level is continuously indicated in the control room. Catalyst circulation rate can be ascertained quickly and accurately by reading the power input to the elevator drive motor from a watt meter.

The carbon burn-off rate and temperatures in the Thermofor kiln are controlled by the valves on the air inlet and flue gas outlet lines. One of the outstanding features of the T.C.C. process is the independent control over each phase of the operation; reactor conditions may be controlled independently of the kiln operation and, likewise, kiln conditions may be adjusted independently of the reactor operation. The reactor is blanketed from the atmosphere by maintaining in the top of the reactor a seal of inert flow gas. The rate of flow of seal gas is governed by the differential pressure control instrument.

Hydrocarbon vapors are segregated in the desired portion of the vessel by maintaining pressure differentials above and below the reaction zone. If either the inert gas or purge steam seal fails then the catalyst feed valve and chopper valve in the line from the reactor are closed automatically.

This process is licensed by Houdry Process Corp., Philadelphia.



Hydroform and Catalytic Polymerization

THE Hydroform unit charges naphtha of up to 50 A.S.T.M. octane number, the process produces 80 per cent or higher of hydroform gasoline or naphtha which shows 80-90 A.S.T.M. octane number. In addition 2 to 5 per cent of the heavy polymer is formed with 11.0° to 15.0° A.P.I. gravity. The blending octane number of main product is more than 100.

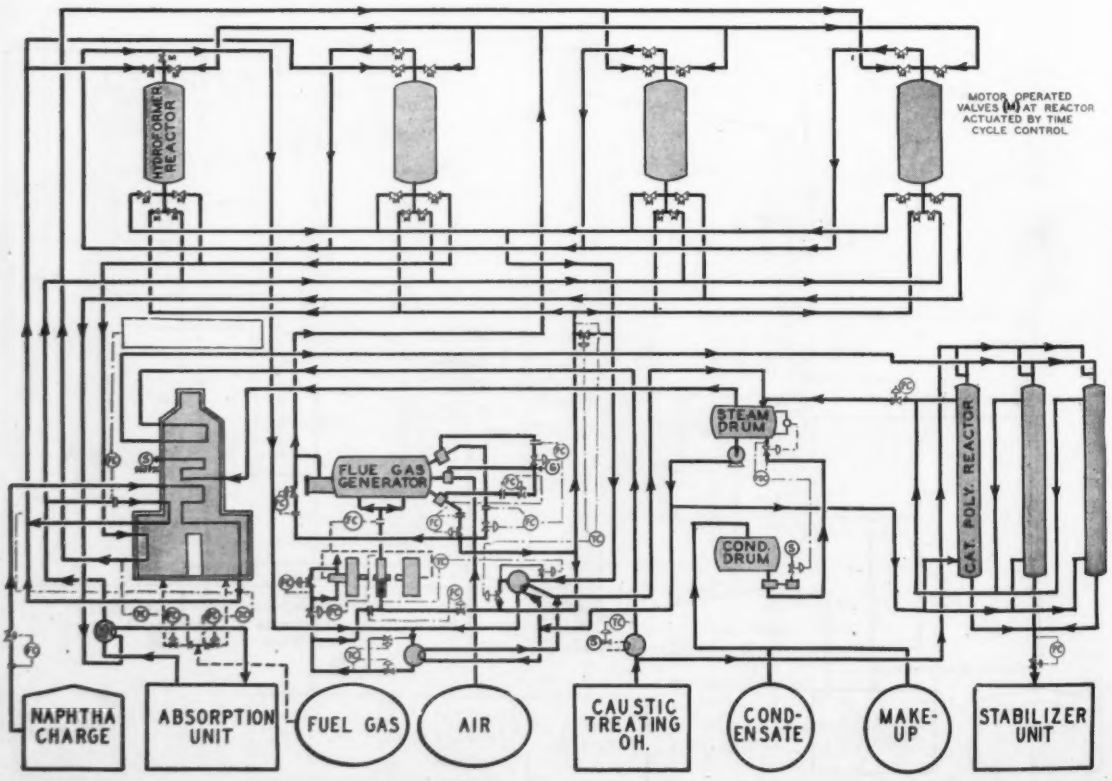
The finished naphtha is highly aromatic, showing up to 50 per cent aromatics, benzenes, and homologs. For this reason the product is probably the best source of benzene, toluene, xylenes, and cumene.

As a typical operation, naphtha is preheated in exchange with hydroformer charge transferring from reactor to cooler, and is introduced into the naphtha heater where its temperature is raised to 1,000°-1,050° F., along with a light hydrocarbon gas-hydrogen mixture; the heated charge enters the reactor at about 950° F., and comes into contact with the catalyst, a metallic oxide.

The partially hydroformed charge is reheated in a second furnace to about 950° F., the reaction being endothermic, and passes through a second reactor to complete the hydroforming operation. The reaction mixture is fractionated to separate gasoline from heavier components, and is stabilized to remove lighter products, a portion of which light hydrocarbons is heated and recycled with new naphtha charge.

While two or more reactors are on stream the reactors containing spent catalyst are regenerated. Flue gas and air mixed in the ratio of four or five to one by volume, to dilute the oxygen content, is heated in a separate heater to 600°-700° F. and forced via blower through the spent-catalyst beds. With a pressure of 250 psig. being maintained the catalyst is regenerated by burning off the deposited carbon, without allowing the temperature of the catalyst to rise to more than about 1,100° F. Part of the hot gases from this regeneration is passed through a reactor in which the catalyst temperature immediately after regeneration is about 700° F. or lower, in order to bring the temperature up to about 950° F. Another portion is sent through a so-called waste-heat boiler.

This process is licensed by M. W. Kellogg Co., New York, and Universal Oil Products Co., Chicago.



Naphtha Polyform

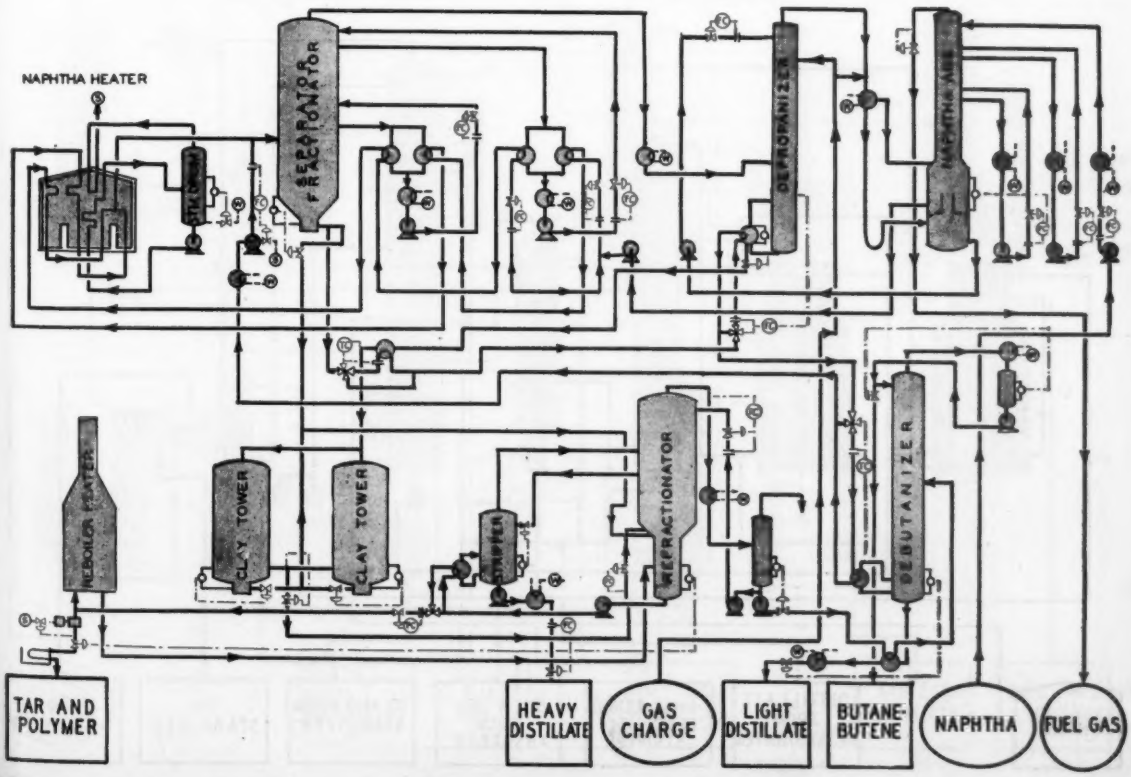
THE Polyform process is a thermal process for upgrading naphthas and low-octane straightrun gasolines to produce attractive yields of motor gasolines having A.S.T.M. octane numbers of 75 to 80 and Research octane numbers of 84 to 93, without the addition of tetraethyl lead. Since essentially all the propanes produced are cycled back through the cracking coils and converted to gasoline and ethane and lighter gas, the yields of gasoline are appreciably higher than could be obtained by reforming to the same octane level. The dilution of the naphtha with gas also permits cracking to higher octane levels than can be obtained by conventional thermal means.

Flexibility of the process is exemplified in the flow sheet presented here. The unit may be operated for maximum yield of vapor pressure gasoline or for maximum yield of B-B plus an attractive yield of debutanized distillate by adjusting the operation of the depropanizer. Extraneous propane and butane gases may also be charged to the process to obtain yields of gasoline amounting to 35 liquid volume per cent from propane, 40 to 50 per cent from butanes, and 75 to 85 per cent from the olefins, propylene, and butylenes.

Recent developments in the process have been the determination of the exact yields and cycle ratios associated with the conversion of propane and butane gas fractions. It has also been found that gas oils may be polyformed with 200 to 300 per cent gas dilutions at the same pressure and temperature conditions as are employed for naphthas. For example, a light paraffinic gas oil can be converted to gasoline with a yield of 60 to 70 per cent and an octane number of 73-76 A.S.T.M. in a single pass, or a light catalytic cycle stock can be converted to 50-60 per cent gasoline of 76-82-octane number. The flow diagram for a single-pass gas oil polyform unit would be essentially the same as the one shown here.

Clear A.S.T.M. octane numbers of Polyform from different charges are about 76, with 3 cc. TEL are 83-84 as typical examples. Research numbers are 86-87 clear, with 3 cc. TEL are about 95.

Polyform and Gas Reversion processes are licensed by Gulf Oil Corp., Pittsburgh, Pa., and Phillips Petroleum Co., Bartlesville, Okla.



Thermal Cracking

A TWO-COIL selective cracking process cracks oils thermally to form gasoline, gas, and residuum.

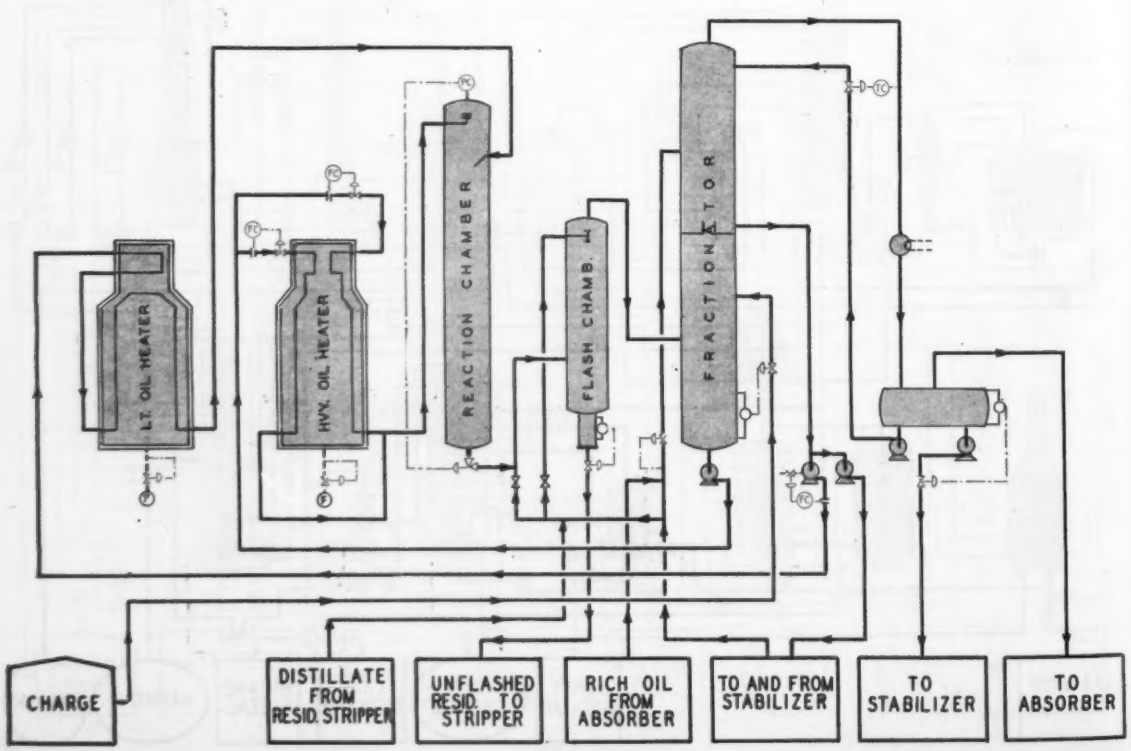
A liquid-level controller on the heavy combined feed level in the bottom of the fractionator controls the charge rate to the unit. Since the heavy combined feed level can decrease only by cracking to form gas, gasoline, and residuum, it limits the amount of fresh feed that can be brought into the unit.

The charge to the heavy-oil heater divides into two coils, each of which is regulated by flow-recording controllers. The charge to the light oil heater is regulated by a flow-recording controller setting the steam rate to the pump. The firing rates to both heaters are manually regulated from the insrument board by pilot-operated pressure-balance valves. These valves compensate automatically for any variation in the fuel-gas pressure. Temperature recorders on the transfer lines of the heaters guide the operator in setting firing rates.

A pressure-recording controller on the reaction chamber holds a fixed back pressure on the chamber and the heaters. Quench to reaction chamber drawoff is manually operated and is guided by a temperature indicator. A temperature indicator on the flash chamber vapor line guides the operator in setting the amount of quench oil to the top of the chamber. A liquid-level controller regulates the bottom drawoff of residuum to the stripper.

A temperature-recording controller on the fractionator overhead regulates the reflux rate to the column. A flow recorder meters this rate. A level indicator on the light combined feed center well tray indicates the amount of liquid overflowing down the column from this tray. A hot-oil stream taken from this tray reboils the stabilizer and then provides absorber lean oil and quench oil. A liquid-level controller on the distillate receiver controls the charge to the gasoline stabilizer.

Thermal cracking processes are licensed by Universal Oil Products Co., Chicago; M. W. Kellogg Co., New York, and other licensors.



HF Alkylation

THE HF alkylation process reacts olefins and isoparaffins catalytically to form higher boiling isoparaffins in the gasoline boiling range. The drawing gives the layout for aviation-alkylate production from butylenes and isobutane.

The butane-butylene charge and the isobutane recycle stream to the contactor are regulated by flow-recording controllers. The static head of the acid which settles out in the elevated acid settler causes circulation back to the contactor. A small side stream of acid is withdrawn to the acid regenerator to maintain acidity.

The temperatures of the acid charge and stripping isobutane charge to the acid regenerator are regulated by pressure controllers on the steam to the preheaters.

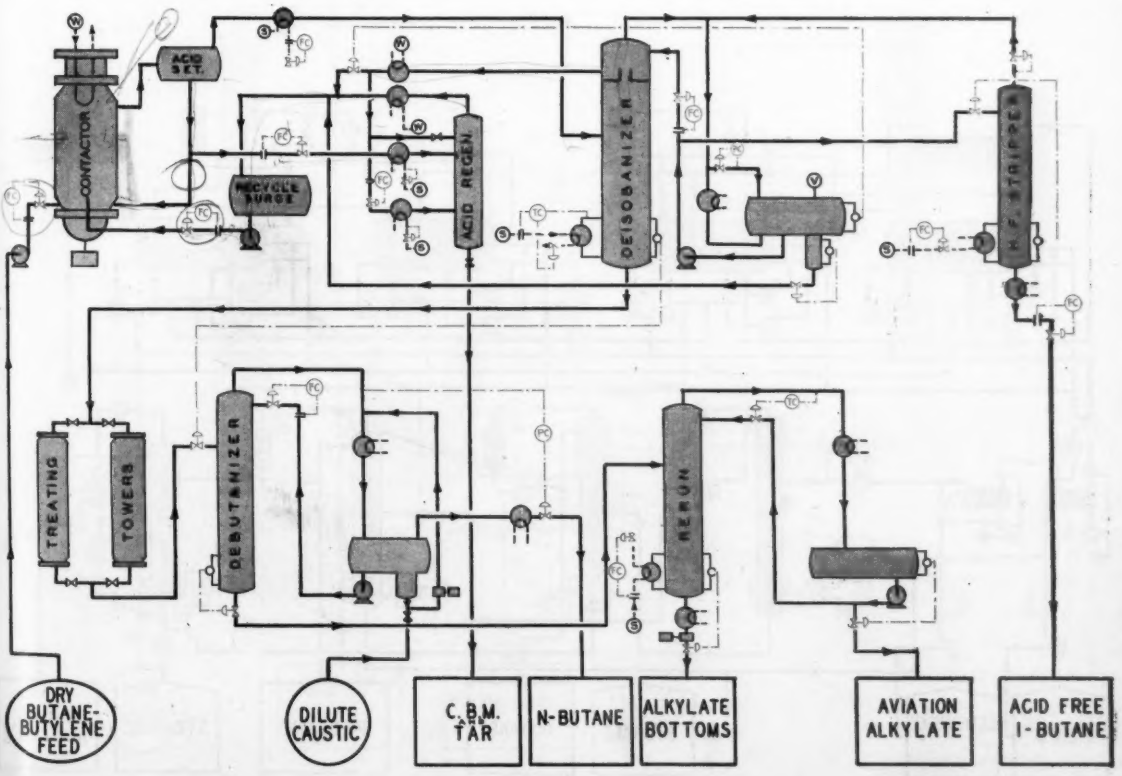
The heat content of the deisobutanizer feed is regulated by a flow-recording controller on the steam condensate from the preheater. The fractionation in the column is regulated by a temperature-recording controller on the reboiler vapor line resetting a flow-recording controller on the steam flow to the reboiler. The bottom level is regulated by a liquid-level controller on the charge to the debutanizer. The column pressure is regulated by a pressure-recording controller on the vapor bypass around the condenser. The receiver level is regulated by a liquid-level controller on the isobutane recycle side-cut flow. The acid phase that accumulates in the receiver drop leg is sent back to the recycle drum by a liquid-level controller.

A liquid-level controller on the level in the bottom of the HF stripper controls the charge rate to the column. A flow-recording controller on the reboiler steam regulates the heat input to the column.

On the debutanizer, the receiver runs full and the column pressure is regulated by a pressure-recording controller on the net make of butane.

A temperature-recording controller on the rerun column overhead regulates the reflux rate.

The HF alkylation process is licensed by Phillips Petroleum Co., Bartlesville, Okla., and by Universal Oil Products Co., Chicago.



Sulfuric acid Alkylation

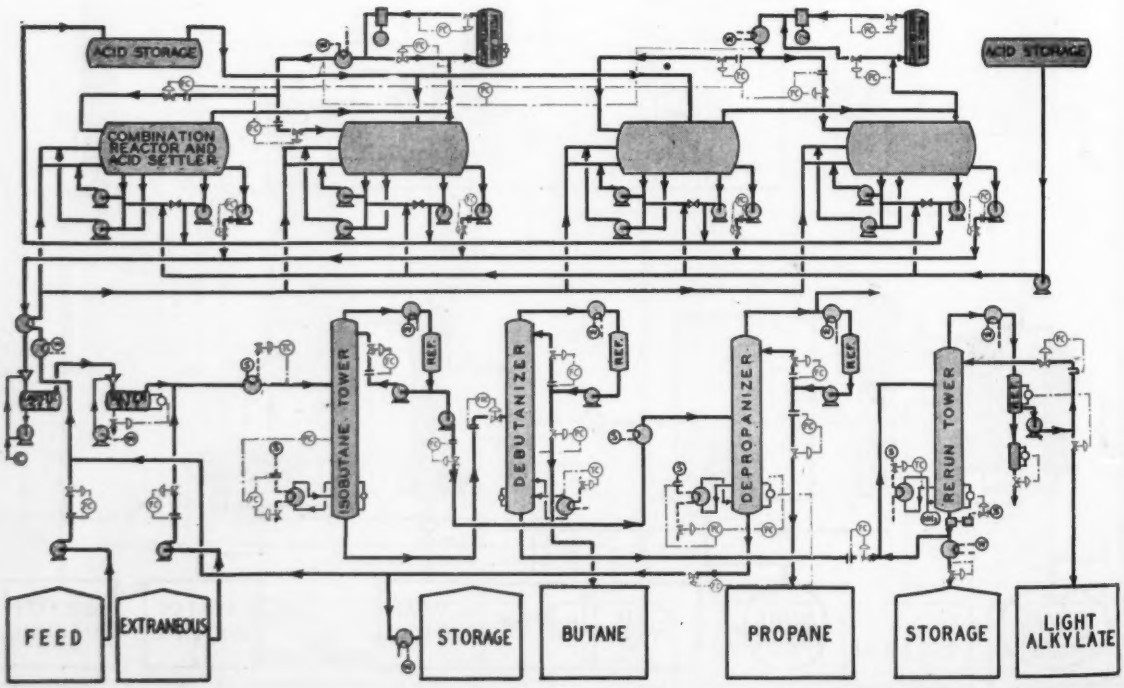
IN operation a stream of light vapors or liquids, a lower percentage of olefins such as butenes, with possibly propylene and/or pentenes, are introduced into a reactor containing sulfuric acid of about 93 per cent strength, although this concentration may vary. Reactor is maintained at about 35° F. This low temperature prevents side reactions with the formation of undesirable byproducts. A contact time of about ½ hour is typical for this step in the process. Fresh acid of 98 per cent is added to the reactor to maintain the acid at the proper strength, acid being withdrawn continuously as the process continues.

To maintain a desired isobutane concentration in the reacting vapors it is usually necessary to isomerize normal butane. The reaction mixture is caustic washed and sent to a fractionator from which butane is taken overhead, alkylate, and isopentane are taken as bottoms, which is split in another tower into pentanes and alkylate overhead, and heavy alkylate as bottoms.

The present theory holds that the olefins are added directly to the acid, forming alkyl sulfates and acid sulfates. The tertiary carbon of the isoparaffin shows a strong affinity for the olefins. By this reaction the hydrogen attached to this tertiary carbon joins one bond of the olefin while the other olefin bond combines with the tertiary carbon itself, making a combined isoparaffin chain, one molecule being the sum of the two reacting molecules.

Ratio of olefin to isoparaffin in the mixture may range from 3 to 1 to 8 to 1; acid-hydrocarbon ratio is of the order of 1 to 1. Yields of alkylate may range up to 175 per cent of the olefin charged, with up to 95 per cent of alkylate of aviation boiling range. Clear A.S.T.M. octane rating may range from 91 to 95, and with 4.6 cc. of TEL may be as high as 108-110. Alkylation has been referred to as a means for reducing vapor pressure while retaining octane number.

This process is licensed by M. W. Kellogg Co., New York, and Universal Oil Products Co., Chicago.



Girbotol

THE Girbotol process for the removal of acidic gases from hydrocarbon gases and liquids is quite simple in principle. It is based on the fact that such acidic gases as hydrogen sulfide, carbon dioxide, etc., are absorbed readily by organic bases such as the ethanolamines.

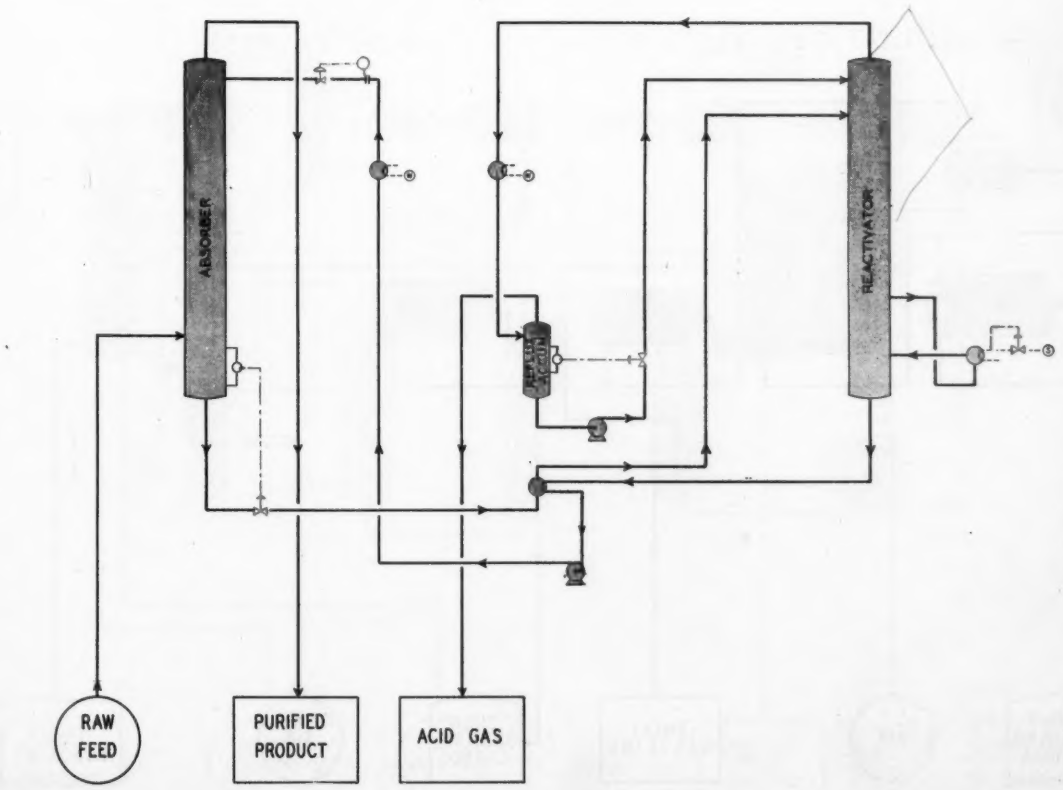
In practice the amine, in the form of mono, di and/or triethanolamine water solution is fed into the top of an absorber under essentially atmospheric temperature. The sour vapors enter the base of this absorber tower and pass upward countercurrent to the water solution. Hydrogen sulfide or carbon dioxide, or both if present, are absorbed by chemical reaction with the amine in the solution, according to the equation:

$$R_xNH_7 + H_2S \rightleftarrows R_xNH_{7+1} \cdot SH$$

This product remains in solution in the reagent and is carried with it to the regenerator unit. The sulfide or dioxide-free vapors pass out the top of the absorber as essentially sulfur free. The foul amine solution is preheated and enters the stripper tower, where the effect of the raised temperature decomposes the unstable amine-sulfide salt. A stripper drum or reboiler is generally combined with regenerators, in which the partially purified solution is heated to remove the last of the sulfide, heating being normally by exhaust steam or other cheap heat source. In case it is desired to remove water vapor also, a final treatment with a dehydrating agent such as diethylene glycol, by countercurrent contact with the desulfurized vapors gives an essentially water-free product. Hydrogen sulfide removal is generally about 99 per cent of that present in the raw vapors.

The essential control equipment includes a flow control on the raw feed, another flow controller on the lean solution inlet to the absorber, flow control on the cooling water to the acid gas cooler, and one also on the steam line to the regenerator reboiler, to govern the stripping temperature. Liquid-level control is installed in the base of the absorber tower.

This process is licensed by Girdler Corp., Louisville, Ky.



Perco

Copper Sweetening

THE Perco copper sweetening process is applied in two distinct methods commonly referred to as the solution process and the solid process. The accompanying flow chart illustrates both of these methods. In either process, if the sour gasoline charge contains hydrogen sulfide or free sulfur, these are removed by a caustic wash prior to sweetening. The caustic wash may be omitted if neither hydrogen sulfide nor free sulfur is present.

In the solution process, the gasoline is continuously sweetened by contacting with the treating solution in a centrifugal pump. The mixture of copper solution and sweetened gasoline passes to a separating tank, from which the used copper solution is continuously withdrawn to the regenerating tank where it is regenerated by blowing with air. The regenerated copper solution overflows to a solution storage tank from which it is recycled. The sweetened gasoline is withdrawn continuously from the separating tank and is given a stabilizing wash to remove any traces of copper.

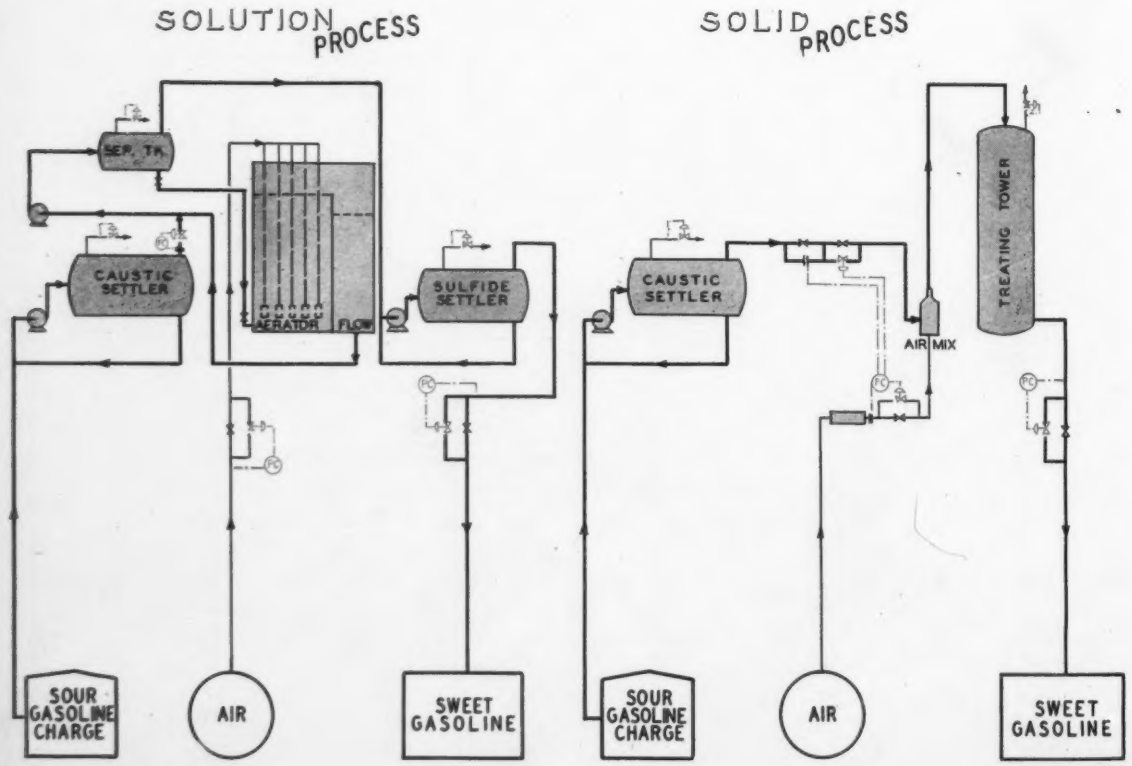
In the solid process the caustic-washed charge is mixed with air and filtered through the bed of cupric chloride-impregnated reagent.

Both the solution and the solid processes are simple to operate and require no unusual control features. In the solution process the sour-gasoline charge is controlled by flow controllers. The quantity of copper solution recycled is controlled by throttling the contact pump discharge. The amount of air for regenerating the used copper solution is regulated by flow controllers to give the desired oxidation potential or degree of regeneration. In the solid process the quantity of air required for admixture with the gasoline is predetermined and is regulated either by use of a proportioning flow controller or by use of separate flow meters on both the gasoline and air streams.

The following example of the liquid treatment of a cracked gasoline is typical of the results obtained by the copper sweetening processes.

	Sour charge	Doctor treated	Perco treated
A.S.T.M. octane number	62.9	61.9	62.9
+1 cc. TEL	68.5	67.8	68.5
+3 cc. TEL	71.7	71.0	71.7
Color, Saybolt	+2	−5	+2
Color, stability	0	−16	+1
A.S.T.M. gum, mg./100 cc.	2.6	0.4	0.0
Induction period, minutes:			
Without inhibitor	130	130	180
With 0.002 per cent inhibitor	320	190	415
With 0.004 per cent inhibitor	485	305	640

This process is licensed by Phillips Petroleum Co., Bartlesville, Okla.



Tannin Solutizer

THE Tannin-Solutizer process obtains product improvement and increase in octane number and lead susceptibility to be derived from sulfur reduction by addition of a simple and efficient tannin-catalyzed oxidation regeneration step to a mercaptan extraction operation employing strong caustic solutions containing mercaptan solubility promoters, termed "solutizers," such as isobutyric acid and/or alkyl phenols.

The process, as illustrated in the flow diagram, consists essentially of three sections: the caustic pretreat, solutizer treatment, and regeneration system. Caustic pretreatment is usually required for removal of strongly acidic components, such as hydrogen sulfide, and in some cases for control of alkyl phenol concentration.

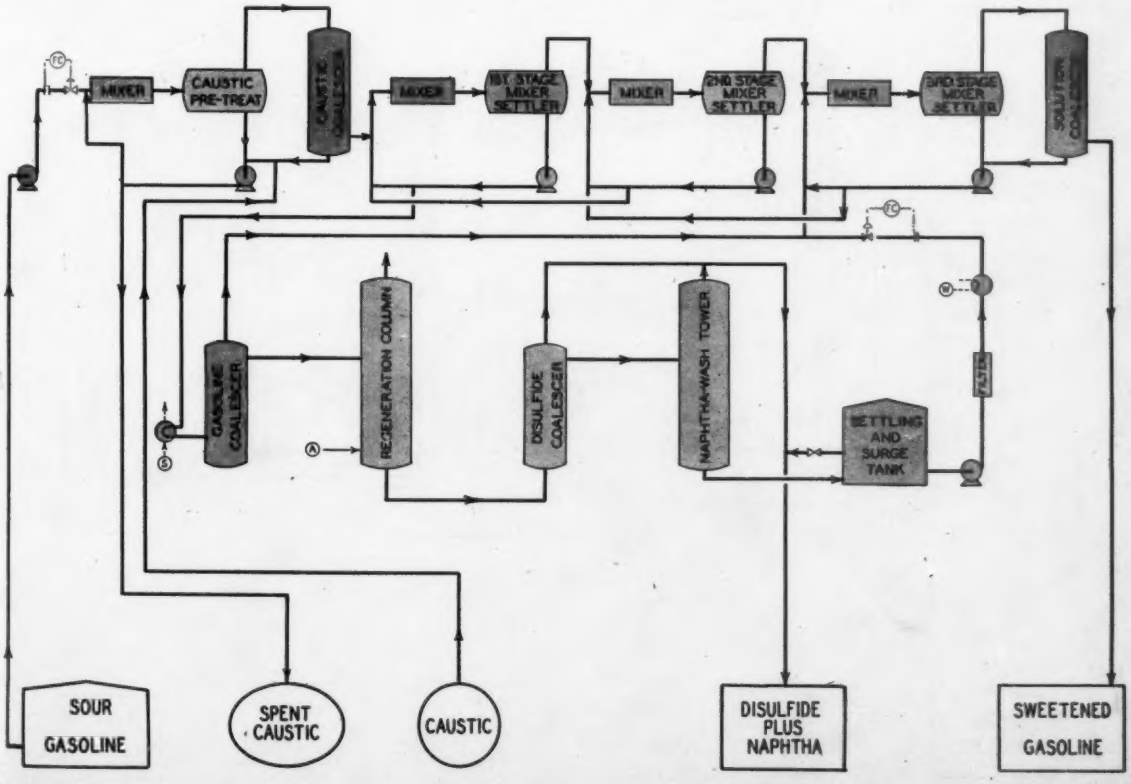
After pretreatment, the sour hydrocarbon feed enters the extraction system in which it is countercurrently contacted with a suitable solutizer solution. The solution may contain added isobutyric acid solutizer, or naturally occurring alkyl phenols.

Treating solution from the extraction step is preheated to a temperature of 110°-130° F., and flows to the regeneration column in which the extracted mercaptans are catalytically oxidized to the corresponding disulfides by air blowing. This operation may be accomplished in a column devoid of packing equipped with efficient air dispersers or in any standard liquid-gas mixing device. The regenerated solution is coalesced for removal of entrained disulfide oil and the portion of this material remaining in solution is removed by a simple countercurrent or batch naphtha wash step.

This process easily achieves mercaptan removal to the 0.001-0.003 per cent weight mercaptan sulfur level when treating a wide range of straightrun or cracked stocks, either low end point or full boiling-range gasolines, having a naphthenic or paraffinic crude source. Mercaptan reduction to the doctor negative specification may be obtained in many cases.

Control in the process is chiefly flow control; flow regulators determine the ratio or proportions of treating agent and naphtha to be treated, the rate of flow from mixer to settler to mixer, etc. Temperature of the spent solution to the regenerator is controlled by exhaust or other steam by throttling the steam to give the desired temperature.

The Tannin-Solutizer process is licensed by Shell Development Company, New York, under its patents and those of Socony-Vacuum Oil Co.



Mercapsol

THE Mercapsol process removes mercaptans from gasoline by extraction with aqueous caustic soda which is fortified with certain naphthenic acid, cresol, and tar-acid types of solubility promoters, and in certain instances with oxidation catalysts. A conventional packed tower is used for countercurrent extraction, but existing multistage mixing and settling equipment may also be adapted to the process. Regeneration can be effected either by steam stripping the mercaptans from the spent solution in the bubble tower, or by catalytic oxidation. Catalytic air oxidation of the gasoline may also be incorporated into the process, either alone or in conjunction with a primary extraction step. The oxidation step does not remove mercaptans, but rather oxidizes them to nonodorous disulfides. A gasoline with low mercaptan sulfur may well be treated by conventional extraction and the spent solution regenerated either by steam or by catalytic air oxidation. Gasolines with large amounts of difficultly removable mercaptans are first conventionally extracted and then finished with a single step catalytic aeration as shown in the flow diagram. The primary purpose of the Mercapsol process is to reduce the total sulfur of the gasoline and thus improve its octane number and lead susceptibility, but the process is also designed to produce doctor sweet gasoline. The process is tailored to each refiner's requirements, and the ultimate design is governed by his required specifications for finished gasoline and the properties of the raw gasoline to be treated. Existing equipment is fully utilized and such factors as cost and availability of utilities such as steam and cooling water are taken into account.

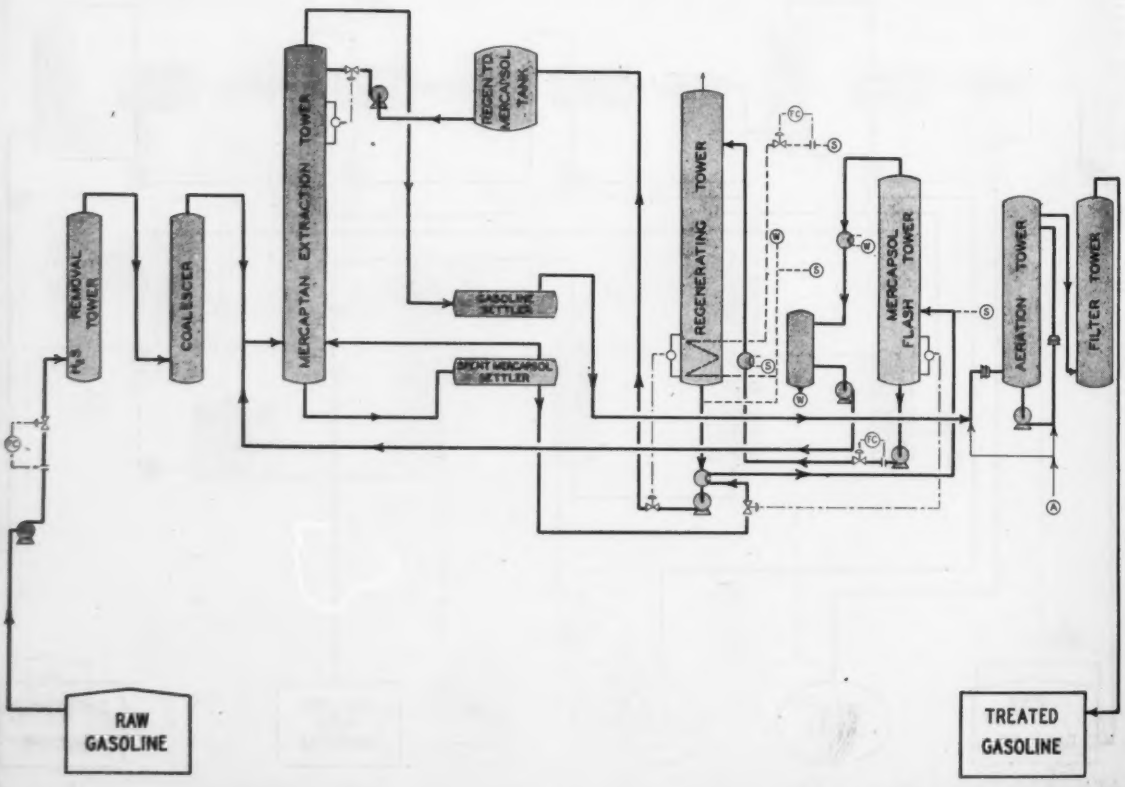
Process is licensed by The Pure Oil Co., Chicago.

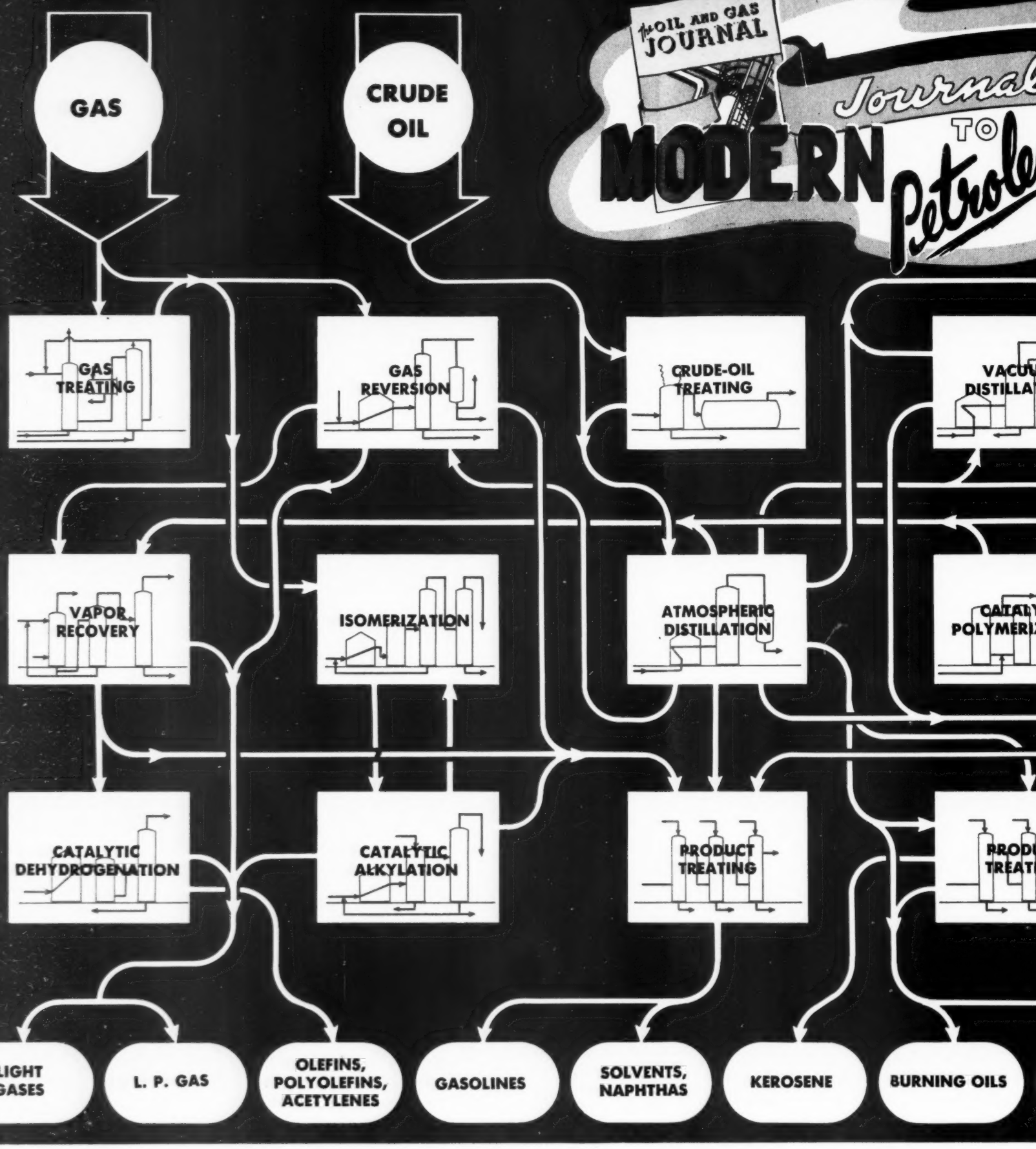
TESTS ON GASOLINE TREATED WITH MERCAPSOL REGENERATED BY AIR BLOWING WITH WOOD-TAR CATALYST

Gaso.—	A.P.I. gr.	R.v.p.	A.S.T.M. distillation, °F. I.b.p.	10%	50%	90%	E.p.	Per cent sulfur RSH	R_2S_n	Total
Raw	57.4	8.5	96	146	256	368	413	0.022	0.004	0.050
Treated	57.3	8.2	102	152	256	364	410	0.004	0.010	0.045

A.S.T.M. Octane Number

Gasoline (cc. TEL/gal.)	0.0	0.5	1.0	2.0	3.0
Raw	66.2	69.9	72.7	76.4	77.8
Treated	66.5	70.0	72.8	76.5	78.0





PRODUCTS FROM PETROLEUM

I. FUEL GAS—L. P. G.

- Domestic fuel
- Industrial fuel
- Plant fuel
- Ammonia synthesis
- Fertilizer
- Substituted hydrocarbons
  - Organic chlorides, bromides
  - Organic iodides, fluorides
  - Alcohols
  - Ketones
  - Aldehydes
  - Acids
  - Glycols
  - Ethers
  - Halogenated ethers
  - Amides
  - Amino acids
  - Mercaptans
  - Sulfides
  - Polysulfides
  - Nitroparaffins
  - Glycerin
  - Acid anhydrides
  - Hydrogen
  - Carbon monoxide
  - Carbon dioxide
  - Dry ice (solid CO_2)
  - Carbon black
  - Gas carbon
  - Lamp black
  - Chlorohydrins
  - Ureas—CO derivatives
  - Mono and Polyolefins
  - Organic salts of inorganic acids
  - Organic salts of organic acids (esters)
  - Refrigerants
  - Organic oxides
  - Organic cyanides (nitriles)
  - Organic cyanates
  - Organic isocyanates
  - Dewaxing, deasphalting solvents
  - Thiokol rubber
  - Dioxane
  - Carbon tetrachloride
  - Polychlor benzenes
  - Alkyd resins
  - Halogenated carboxylic acids
  - Mono, Di and trichloro acetic
  - Mono, Di and trichloro propionic
  - Halogenated alcohols
  - Chloroethanol; chloropropanol
  - Chlorobutanol
- Cycloparaffins
  - Cyclopropane
  - Cyclobutane
  - Cyclopentane, etc.
- Alkylcelluloses
  - Methyl
  - Ethyl
  - Propyl
- Alkyloxides
  - Methyloxide
  - Ethyloxide
  - Propyloxide
- Alkyl nitrates
- Alkyl nitrites
- Siloxanes
- Silicones

II. OLEFINS, POLYOLEFINS, ACETYLENES

- Plastics
- Plasticizers
- Resins
- Rubber, synthetic
  - GR-S
  - GR-N (butyl)
  - Isoprene (neoprene)
- Olefinic alcohols
- Olefinic aldehydes
- Olefinic acids
- Olefinic amines
- Olefinic amides
- Butadienes
- Pentadienes
- Vistanex
- Synthetic lubricants
- Low-mol-wt. polymers
  - Disopropylene
  - Disobutylene
  - Disopentene
- Alkylation reaction products
- i-Paraffin-olefin reaction products
- Aromatic-olefin reaction products
- Aromatics synthesis
- Alkyl phosphate esters
- Cyanoaliphatic acids
- Carbon disulfide
- Diguanidine derivatives
- Fatty acids
- Dichlorodifluoromethane (Freon)
- Halogenated cycloparaffins
- Metalloalkyls (tetraethyl lead)
  - Benzene—toluene
  - Xylenes, naphthalene
  - Anthracenes—phenanthrene
  - Styrene—pyrene
  - Fluorene—chrysoprene
  - Cumene—alkylbenzenes
  - Polyalkylnaphthalenes
  - Polyalkylanthracenes
- Acrylonitrile
- Acrylic (acid) esters, resins
- Methacrylic (acid) esters, resins
- Vinyl esters, resins
- Vinylidene chloride resins
- Polyvinyl alcohol
- Polystyrene resins
- Polyethylene resins
- Sulfonic acids
- Polyvinyl pyrollidone (synthetic blood plasma)
- Olefin oxides
- Arylolefins
- Ethylene glycol and others
- Fatty acids
- Ethers
- Ketones
- Alcohols
- Acids
- Synthetic lubricants
- Olefin polymers
- Olefin peroxides
- Acetylene and its derivatives
  - Acetone and other ketones
  - Welding fuel
  - Acetylide salts
  - Explosives
  - Detonants—brisants
  - Synthetic benzene, toluene, etc.
  - Synthetic acetic acid; anhydride
  - Halogenated acetylenes
  - Acetylene tetrachloride
  - Acetylene tetrabromide
- Acetonitrile
- Divinylacetylene
- Sulfur dyes
- Glyoxal
- Ozonides
- Methane sulfonic acids
- Mustard oils
- Acetates
- Thiophenes
- Vinyl halides
- Vinyl sulfuric acid
- Nitroacetylene
- Oxygenated acetylenes
- Polyacetylenes
- Acetylenylamine
- Butyl alcohols
- Synthetic gasolines
- Styrene
- Polyvinyl resins
- Unsaturated ketones
- Cuprene polymer
- Aldols
  - Crotonaldehyde
  - Hydrotolualdehydes
  - Hydroxybutyrates
  - Glyoxylic acid
- Dye intermediates
- Ethers
- Acetals
- Acetonyl acetone
- Biacetyl
- Synthetic drying oils
- Light and heavy oils
- Naphthenes
- Cuprene fillers for linoleum and plastics
- Methyl methoxyallene
- Acetylene—Ketone derivatives
- Acetylene—Acid derivatives
- Acetylene—Alcohol derivatives
- Acetylene—Nitrite derivatives
- Unsaturated metallo-organic compounds
- Vinyl-alkyl cycloparaffins
- Hexachloroethane
- Trichloroethylene
- Grease solvent
- Dewaxing solvent
- Insecticide
- Floor and shoe polishes
- Migraine remedy
- Polyhalogenated acetylenes
- Pinacol
- Alkyl glucosides
- Phenol-acetylene resins
- Hydroxymethylxanthene, Hydroxymethylfluorene
- Anaesthetics
- Vinyl thioethers
- Ethylidene diesters
- Stilbene
- Diphenyl ethane
- Dibenzyl
- Phenanthrene
- Anthracenes, alkyl
- Xylene
- Mesitylene
- Pseudocumene
- Pyridine bases
- Quinaldine
- Selenophene
- Diacetylene
- Dipropargyl
- Polysulfones
- Deuterioacetylene, and Hexadeuteriobenzene

III. GASOLINES, MOTOR FUELS

- Motor gasolines
  - Third grade
  - Housebrand grade
  - Premium grade
  - Military all-purpose grade
- Aviation gasolines

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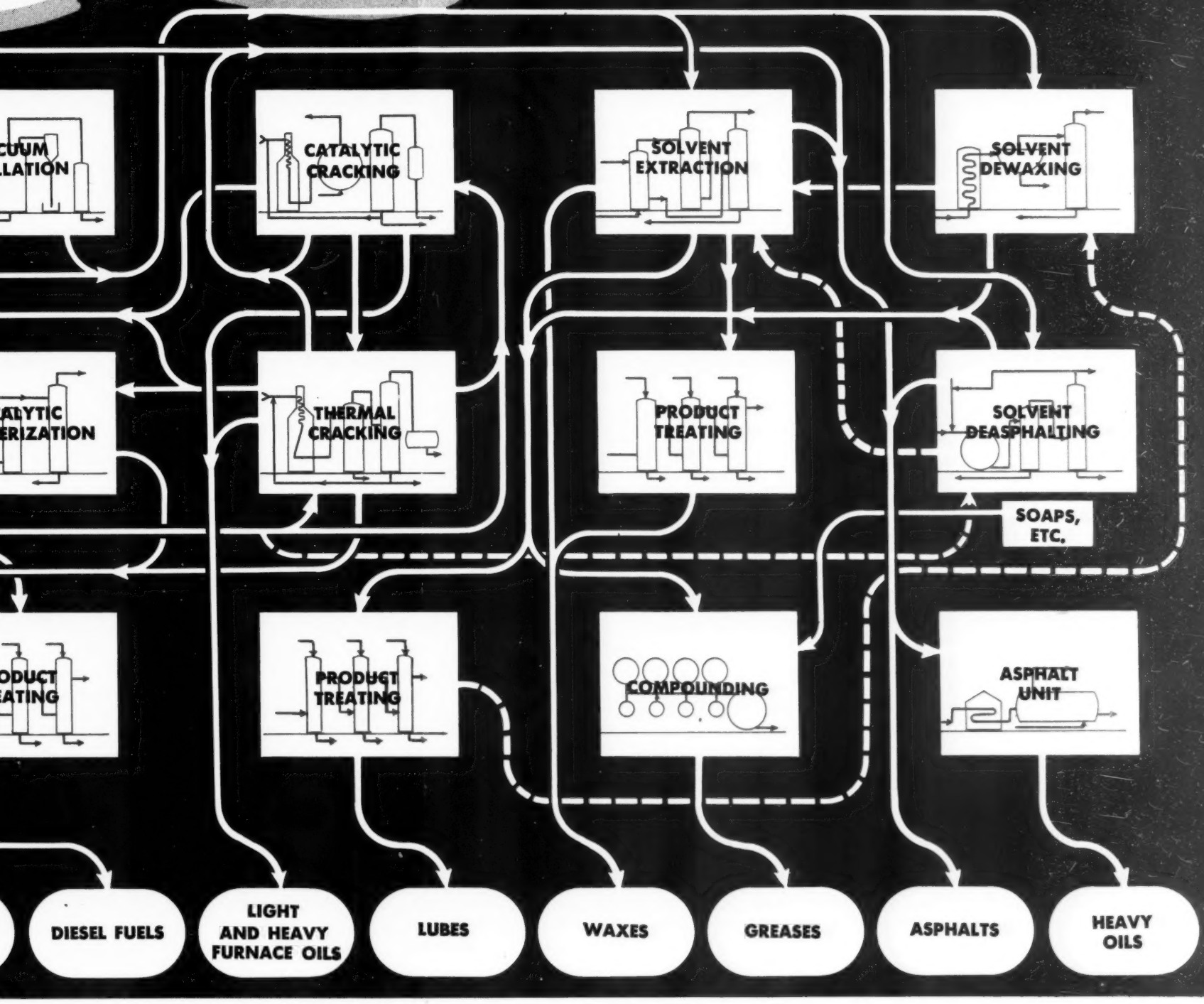

Military (fighting) grade
Military (training) grade
Commercial grades
Tractor fuels
Gasoline (gas generator)
Stove gasoline (naphtha)
Aliphatic peroxides
Naphthenic peroxides
Oxygenated motor fuels

IV. SOLVENTS, NAPHTHAS

Dewaxing solvents
V. M. & P. naphthas
Cleaners' naphthas
Insecticide solvents
Lacquer diluents (resin solvents)
Rubber solvents
Mixed higher aliphatic aldehydes
Mixed higher aliphatic alcohols
Mixed higher aliphatic acids
Soap naphthas
Alkyl oxides
Gas-machine gasoline

V. KEROSENE

Illuminating fuel
Heating fuel
Cooking fuel
Refining chemical byproducts
  Nitrogen bases
  Pyridines
  Pyridine carboxylic acids
  Alkyl pyridines
  Quinolines
  Tetrahydroquinolines
  Di and trimethyl quinolines
  Phthalones
  Dicarboxylic quinoline acids
  Diazines
  Pyrindane
  Pickling inhibitors
  Antoxidation inhibitors
  Insecticides
  Germicides
Gas-turbine fuels
Jet-engine fuels

VI. BURNING OILS

Lamp oils
Stove oils
Flotation oils
Lighthouse oils
Signal oils
Higher alcohols
Higher acids
Higher aldehydes
Stationary-engine fuels
Orchard fuel oils

VII. DISTILLATE FUEL OILS

Domestic heating
Industrial heating
Metallurgical fuels
Water-gas carburetion
Diesel fuels
Locomotive fuels
Slow-speed diesel fuels
High-speed diesel fuels
Cut-back oils, for
  Heavy fuels
  Asphalts—road oils
Gasoline recovery oils

VIII. LUBRICANTS

Gasoline-engine lubricants
Automotive crankcase oils
Tractor oils
Stationary-engine oils
Aviation-engine oils
Diesel-engine lubricating oils
Locomotive-engine oils
Steam-engine oils
Steam-turbine oils
Gas-turbine oils
Textile oils
Sewing-machine oils
Recoil oils
Soluble oils
Cutting oils
Extreme-pressure oils
Hypoid-gear oils
Car-journal oils
Wire-drawing oils
Core oils
Air-compressor oils
Transformer oils
Medicinal white oils
  Internal lubricants
  Ointments
  Creams
  Salves
Technical white oils
  Spray oils
  Bakers'-machinery oils
  Fruit-packers' oils
  Candy-makers' oils
  Egg-packers' oils
  Wool oils
  Leather oils
Switch oils
Tempering oils
Ice-machine oils
Ink oils
Transmission oils
Meter oils
Spindle oils
Crusher oils
Hydraulic oils
Elevator oils
Marine oils
Penetrating oils
Chain and wire lubricants

IX. GREASES

Cup greases
Journal greases
Lime-base greases
Soda-base greases
Aluminum-base greases
Lead-base greases
Zinc-base greases
Driving-journal greases
Rod-cup greases
Graphite greases
Axle greases
Mine-car greases
Cold and hot-neck greases
Launching greases
Slushing greases
Calendar greases
Automotive greases
  Wheel-bearing greases
  Universal-joint greases
  Steering-gear greases
  Water-pump greases
  Chassis greases

X. PARAFFIN WAX

Petrolatum
Sealing waxes
Waxed paper
Matches
Protective coatings
Oxidation products
  Humic-type acids
  Fatty acids and anhydrides (Acids C_1 to C_{14})
  Hydroxy acids
  Lactones
  Lactides
  Succinic acids
  Lactic acid
  Dibasic acids
  Higher alcohols
  Higher aldehydes
  Higher ketones
  Higher esters
  Insecticides
  Compounded lubricating oils
  Pour depressants
  Antifoam agents
  Extreme-pressure lubricants
  Heavy olefins and polyolefins
  Pyrones
Explosives
Medicinal products
  Salves—pharmaceutical carriers—unguents
Cosmetics
  Face creams
  Base and vanishing creams
Aliphatic nitrites
Road-material plasticizers
Leather dressings
Shoe polishes
Furniture polishes
Detergents
Film-strength agents
Wire-drawing lubricants
Covering materials
Roofing paper
Wall covering
Damp-proofing coatings
Laundry wax
Candle wax
High-melting-point wax
Microcrystalline wax
Dental waxes

XI. ASPHALTS AND HEAVY OILS

Heavy fuel oils
Road oils
Road asphalts
Asphaltic concretes
Dust-laying oils
Asphaltic emulsions
Roofing materials
Asphaltenic compounds
Olefinic heavy oils
Heavy organic sulfur compounds
Wood-impregnating asphalts
Insulating materials
Resins
Petroresene
Paper size materials
Additives for rubber
  Balata, gutta-percha, chicle
Paint and lacquer resins
Laminated paper
Molding binders
Briquette binders
Pipe coatings
Asphalt sheet
Waterproofing cement
"Tar" paper
Making electrodes, cores, etc.
Tree surgery asphalts, etc.
Soundproofing
Insecticide-fungicide
Waterproofing textiles
Acid-proof tanks, containers
Electric-windings impregnants
Coating electric wires
Battery seals
Rubber substitute
Brake linings, friction elements
Asphalt-cork blocks
Asphaltic tile—roofs, floors
Burial vaults
Phonograph records
Depilatories
Typographic inks
Joint-caulking asphalt
Plastic slate cement
Bituminous enamels
Asphalt mastic
Bituminous revetments
Asphalt pipe
Asphalt-cellulose ester lacquers